THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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AT HOME AND ABROAD.

WE are all anxious to know the other man's impressions regarding the industrial outlook. The holiday season in England is over, and we have all got our heads into business again ready to take full advantage of every opportunity that the trade season shall present.

That electrical men of all departments have returned from their perambulations with a keen interest in subjects relating to their profession and industry, is evidenced from the large space that we are called upon to devote to "Correspondence" in this issue. We welcome few things more heartily than we do this willingness on the part of electrical engineers to enter spontaneously into the consideration of the matters, both technical and trade, that we select for their interest and edification. Nothing but good can come to an industry whose representatives take a live writing interest in its various concerns. Sometimes we hear of this or that well-known man who has views worth consideration on a subject of the hour, but he "never writes to the Press," and so, excepting that his opinions sometimes receive attention over a postprandial cup of coffee, he is hiding his light under a bushel. We have more regard for the position of the man who "cannot" (or thinks he cannot) write, but who is bubbling over with ideas that he would impart to others were he possessed of the telling ability. It frequently happens that when "practical" (we believe that is the right term) men of this latter class do put their pens to paper editors find it well worth while to dot the i's and cross the t's because of the value of the ideas they are able to express as the result of their practical experience in intimate touch with machines and apparatus, and those who operate them.

Another reader who is more reluctant to communicate his views than we could wish is the electrical engineer resident in the Colonies or in foreign countries. The whole world is getting nearer together every year, and the news from Home reaches these countries more quickly, so that there is really no reason why those who go out from the Mother Country to posts in foreign parts should feel that they are out of touch with things. Often and often have electrical men on returning from the Colonies complained to us that their several years' residence abroad has put them out of touch with the men at home, and their systems and ways. Sometimes they experience considerable difficulty in getting back into the running again. We put it to them that by engaging in interchange of thought in our pages from time to time, about the questions of the moment, they will be more likely to know and be known when they return Home—if it ever by choice or perforce be their lot to do so. There are some Colonial electrical engineers who would be practically unknown or forgotten by the bulk of their *confrères* in this country but for the medium of the ELECTRICAL REVIEW.

Unfortunately, there is a strange inability—we will not say unwillingness—on the part of some of our friends to do, when they reach their destinations abroad, all that they kindly promise when we bid them farewell. We wonder whether these gentle hints will be a reminder to some old friend who has developed the silent habit of the Colonial? We voice the feeling of the whole electrical trade in welcoming all the news that is of any value regarding the electrical possibilities of the world, and those of our friends who desire to assist the British electrical manufacturer to maintain his position or to improve it abroad, have it in their power to show a preference by throwing off their silent attitude, and

in place thereof, contributing their quota to this compendium of electrical information, whether their assistance take the form of criticism administered or advice given. Few matters discussed in our pages are of such ephemeral interest that the foreign reader need feel that his views are not worth sending because of the time occupied in mailing. We want the Electrical Review to be more instrumental than ever before in maintaining the old familiarity between the Briton at home and the Briton beyond the seas. The more that intimate relationship becomes weakened the worse will it be for our chances of doing increased electrical trade, for the allurements of other countries which have already done much to nurse the British Colonies and their engineers, are not imaginary.

But "Correspondence" may be plentiful without being any sort of an indication as to the industrial position. More useful evidence in that connection may be found in the opinions expressed by those who are travelling about in the various centres of industry in the provinces. These are nothing if not hopeful, and we have no doubt that revival would have come in this country far more speedily and more markedly, but for the political unsettlement that prevails, and has prevailed for some months past.

We observe in the *Times* "Electrical Notes" this week, this remark: "The distinct improvement to be observed in the volume of electrical manufacturing business, may cause some qualified satisfaction in that it is mainly attributable to fierce competitive effort to obtain foreign orders." "The Home Trade," the writer proceeds, "continues to be almost hopelessly dull." We are glad, first, that the writer observes a distinct improvement, which is in accord with the news that reaches us, but while we are regretful that the Home Trade is not yet in that much improved position for which we have all hoped so long, we are more pleased than our contemporary appears to be that foreign orders are being secured. We have urged the necessity for the foreign campaign in season and out of season, and the recent articles that we have published discussing new opportunities under "Notes on Trade Abroad" have, we are glad to know from various sources, given an added stimulus to this activity. These articles have been read with interest by the right men, and we shall continue their publication covering other fields where it is necessary for the manufacturers of this country to make bold efforts.

For the Home Trade we shall hope for a more settled political position before long whether there be a General Election or not. Governments that interfere with industry are bound to prolong nervousness and unsettlement. Irrespective of what the actual cause may be that shall clear the political atmosphere, we feel that the clearing up can only be followed by a state of things which shall make more financial support available for legitimate enterprises enabling the already commenced industrial revival to proceed without hindrance. But the political position is far from being the only cause of the present lack of home electrical orders. Only this week it has been suggested to us that we should take a tour of certain parts of this country, noting the bias of some engineers for plant of Continental manufacture in connection with the installation of which the ordinary matter of price does not enter. We are confidently assured that this prejudice, coupled with a deficiency in the matter of salesmanship, loses far more business for us than do prices. As a matter of fact, it is said that British prices for some classes of work are so undercut that the foreigner would not attempt to go below them.

WASTEFUL DRIVERS.

While efforts are being made in every direction to reduce the consumption of energy per car-mile by means of multifarious meters, hardly enough attention is paid to the prime source of the waste—the motorman himself. More frequent, or more widespread appeals to his commonsense, an endeavour to recognise and to encourage a feeling of loyalty in him, might help the meters to do their work more successfully. The inevitable first feeling of the motorman about meters is that they are spies, and, worse still, spies that cannot be circumvented. Signals may do very well to give warning of the whereabouts of a flesh and blood inspector, but the sneaking meter is there all the time, locked up in a cupboard, but all eyes and ears and never popping down a side street for a meal or a smoke.

Now it is very hard to believe—in fact, it is incredible—that more than the tiniest percentage of any body of motormen will drive badly for the pure mischief of the thing. If they were unreasoning children, they might be imagined to do all the acts which waste current and damage the car for fun or from malice; but they are men of responsible age, who may be supposed to have some interest in their vocation and to care a little for the affairs of their employers. It is not difficult to give any body of respectable men that amount of credit, and it is both easier and more pleasant to do so than to brand the whole lot as a set of selfish scamps, whose anxiety is not to deserve praise but to escape punishment. Half the trouble in the world is caused by under-rating the man below one, and a good part of the balance is due to jealousy of the man above. But let us start by understanding the man below. Let us, if anything, rate him too highly, give him credit for virtues which are dormant and undeveloped, make him above all think that we are prepared to trust him.

Let us do this, and ten to one but we shall be surprised to find that he has qualities of much the same *timbre* as our own, shades of quality indeed which we thought no one below ourselves could possess.

Before threatening, shall we try educating; before punishing, something more sympathetic than rules?

Just as no one ever learned grammar or bridge from the rules alone, or law from Acts of Parliament, so no motorman ever was taught his whole duty to his employer by studying the rules and regulations devised by the latter.

Publish rules, by all means, but do not leave them to stick half-way in the driver's brains like whole maize in a chicken's craw. Pound them up, and help him to digest them, by example, demonstration, lectures, examinations of a suitable, not over pedagogic, type. Give him concrete examples of economy and waste drawn from actual practice from his own and from other systems, circularise him with well-chosen extracts from technical journals, put the journals themselves within his reach, and make him feel at last that it is not a shameful thing to improve; that the service of an employer is part of the service of God.

Saving the Pence.

How much the smaller economies mean to a business is well exemplified by the calculations concerning material scrapped before its time which appear frequently in all kinds of journals. The matter of brake-shoe waste has been mentioned in these columns more than once, but, probably not for the last time, it arises again out of a paragraph in a recent number of an American contemporary. There, it is remarked that the foremen of different depôts on the same system often have widely divergent ideas about the amount of wear which can be taken out of brake-shoes. In one case the average weight of scrapped shoes was 9·5 lb., while the average weight at a neighbouring car-shed was 17·2 lb., but such extremes must be rare. It is undoubtedly true, however, that engineers and foremen in too many instances do not keep the jealous eye upon the scrap-heap which the possible value of the latter to their employers calls for.

One American company estimated that it would have to carry 40,000 more passengers yearly to recoup the loss which would be occasioned if the car-house foreman scrapped the brake shoes at 10 lb. instead of at 6·3 lb.

The same thing applies to every article which is subject to frequent renewal, and many a lesson has been learned, many a pound saved, and many a mechanical improvement made, by men who have kept both eyes on the scrap-heap.

PROTECTION AGAINST HIGH-PRESSURE DISCHARGES.

Of all the many problems that have taxed to the utmost the ingenuity and skill of the engineer during the evolution of high-pressure transmission of electrical energy, probably none has proved more elusive, or been more earnestly debated than that which forms the subject of this article. In the early days, when 2,000 volts was called high pressure, and both the distributing mains and the generating and transforming plant were of very modest dimensions, oscillatory discharges were unknown as such—they existed, no doubt, but there were so many other causes of breakdown, and so many breakdowns, that their presence was not specifically recognised.

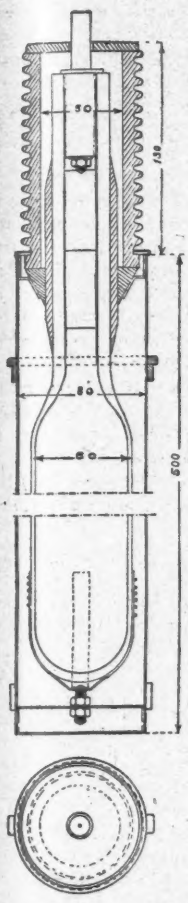


Fig. 1.—Section and Plan of Moscicki Condenser Tube.

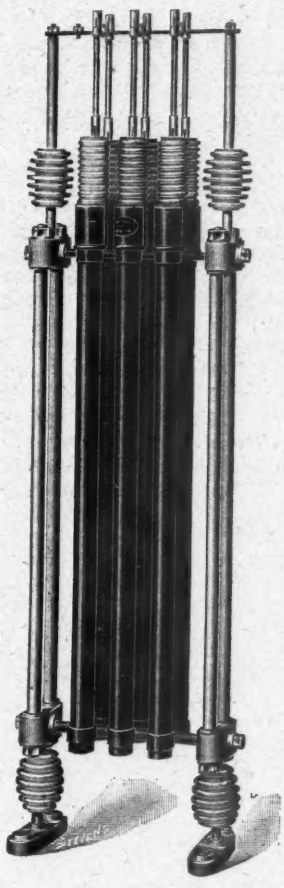


Fig. 2.—Battery of Tubes.

The immense improvement in the construction and insulation of electrical apparatus during recent years, combined with the enormous increase in the pressures employed, has changed all this. Electrical apparatus has been developed to a pitch at which it is as reliable as any other class of mechanism, and all ordinary failures having been eliminated or "marked down" to their true source, the troubles due to oscillatory discharges have been isolated and identified—a process greatly aided by the progress made in a totally different direction, namely, the art of wireless telegraphy.

The identification of the enemy, however, is only the first step; to frustrate his mischievous attacks has proved an even more difficult problem. "At home" in this country, happily, where most of our cables are underground, and lightning discharges are less frequent and less violent than abroad, we have not been greatly inconvenienced by atmospheric phenomena; but in other parts of the British Empire, and in the United States, for example, where overhead lines are the rule, and the climatic conditions are far more severe, protection against lightning discharges and surges due to them is one of the most vital and pressing problems of the day. In visiting foreign installations, it is usual to find most elaborate and costly sets of apparatus in the lightning arrester room, which is regarded as an indispensable part of the equipment. But the wide differences existing between such installations, and their frequent failure to fulfil their function, show clearly that the systems in vogue are still far from attaining either uniformity or a high degree of efficiency.

While we are, as mentioned above, less subject than other countries to trouble from lightning, the almost universal use of underground cables in this country has brought with it troubles of its own, particularly as the length and capacity of the networks have increased; for the sudden interruption or completion of the connection between a system of highly inductive apparatus, such as generators or transformers, and a network of cables possessing large capacity, is capable of giving rise to very violent surges and of producing extreme variations of pressure which may, and often do, result in breakdown. No system can be guaranteed against the occurrence of such sudden changes in the circuit; a short-circuit on the line, or the opening of a switch, may equally lead to the undesired effect referred to, and the only thing that can be done in this case also is to mitigate the risk by making suitable provision for controlling the surges of energy.

Thus there are two principal cases to be provided against—oscillations and surges due to atmospheric phenomena, and those due to sudden changes in the condition of an underground network of cables possessing large capacity.

The apparatus usually adopted to protect against lightning discharges generally consists of various combinations of spark-gaps and high resistances; the former to disconnect the line wholly from earth at ordinary working pressures, and the latter to prevent an excessive rush of power current when the gap is bridged by a spark, and to prevent the establishment of a resonating circuit consisting of the gap, the resistance and the inductance of apparatus connected with the line, which may lead to precisely the fault which it is desired to correct. But the presence of the high resistance unfortunately largely defeats the main purpose of the device, by choking down the current set up by a high-frequency discharge so much that the pressure rises to excessive values. To cope with this class of discharge, capacity is necessary, which, while almost opaque to currents of ordinary frequency, transmits high-frequency currents with

Fig. 3.—A Large Condenser Installation.

practically no obstruction to their flow. In the case of underground cables, what is wanted is a device which will set a limit to the rise of pressure at the end of a cable, but which need not possess much capacity, the frequency in this case being comparatively low. To meet these cases the Moscicki condenser, described in our issue of September 27th, 1907, has been adapted, together with the Giles "electric

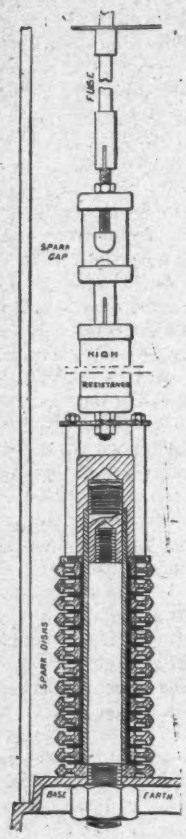


Fig. 4.—Section of Giles Electric Valve.

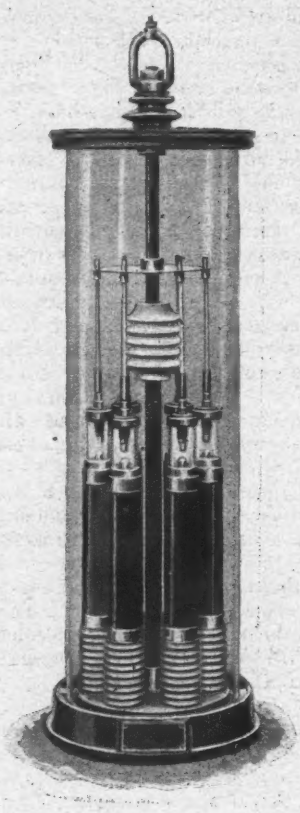


Fig. 5.—Unit Set of Giles Valves.

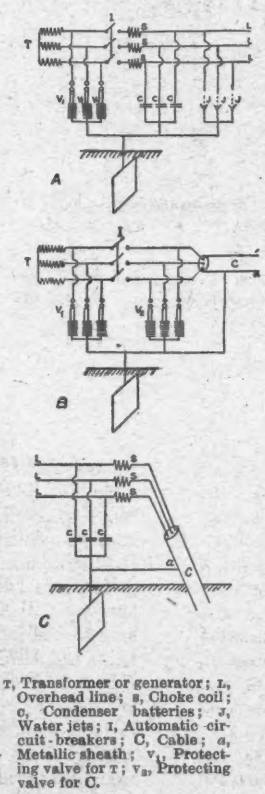
valve"; both of these devices are controlled throughout the British Empire by Messrs. Isenthal & Co., of 85, Mortimer Street, W., who have lately commenced the manufacture of the apparatus in London.

The construction of the condenser, in its latest form, is shown in fig. 1, p. 523, which gives a section of a condenser of 0·002 mfd. capacity, suitable for a pressure of 60,000 volts. As previously explained, the dielectric consists of a glass tube, thickened at the neck near the edges of the coatings where the maximum stress occurs, and supported by a porcelain insulator within a metal tube. The armatures of the condenser are heavy coatings of silver, the outer being protected by an additional coating of electro-deposited copper, and the space between the latter and the outer tube is filled with glycerine, which cools the tube. Substantial connections are provided, and each inner armature has in series with it a high-tension fuse, which isolates any faulty element without affecting the rest. The tubes—which are made in many sizes—are assembled in batteries, the connections being carefully arranged so as to give the minimum self-inductance; fig. 2 shows such a battery, with the fuses in position, while fig. 3 shows a large installation of similar units in a Continental power station. The number of tubes required may run into thousands, as in several existing stations abroad.

The Giles valve, which fulfils the function of a potential limiter, is illustrated in figs. 4 and 5; the former shows a section of the device, and the latter a set of valves assembled within an outer glass cylinder. The valve consists of a high-pressure fuse, spark gap, high resistance and a series of zinc spark disks, separated by mica, the last disk being earthed. The effect of a rise of pressure at the terminals of this device is first to break down the spark gap and charge the condenser formed by the uppermost disk and the central tube, but the capacity being very small, the current is also small, and the drop of pressure across the gap and resistance is correspondingly small. If, then, the pressure remains high enough to span the gap between the first and second disks, a spark takes place there, producing a further drop of pressure, and so on until the potential difference across the main spark gap is insufficient to maintain conduction and the discharge ceases. The disks, as it were, overflow one after the other, until, in the case of an extremely heavy surge, the spark passes completely from top to bottom—but for a fraction of the whole period only. In any case, the obstruction in the path to earth is automatically adjusted to suit requirements.

It may appear that this device is subject to the objection mentioned above as applying to the horn arrester with a high resistance in circuit—namely, that, if the resistance is high, the apparatus is ineffective, and if the resistance is low, resonance may occur. But, in practice, a number of these small elements are put in parallel, as shown in fig. 5, and as it is impossible, even were it desirable, to make these all of identical dimensions and properties, the individual elements come into action at different instants and resonance never occurs. We are informed that the device has proved its efficacy in numerous installations both in this country and abroad.

It remains now to show how these two apparatus are employed for the protection of cables, transformers, &c. The diagrams in fig. 6 illustrate the three leading cases: (A) the protection of a generating or sub-station connected with an



T, Transformer or generator; L, Overhead line; S, Choke coil; C, Condenser batteries; J, Water jets; I, Automatic circuit-breakers; C, Cable; a, Metallic sheath; V_1, Protecting valve for T; V_2, Protecting valve for C.

Fig. 6.—Connections of Apparatus for Protection of Cables and Transformers.

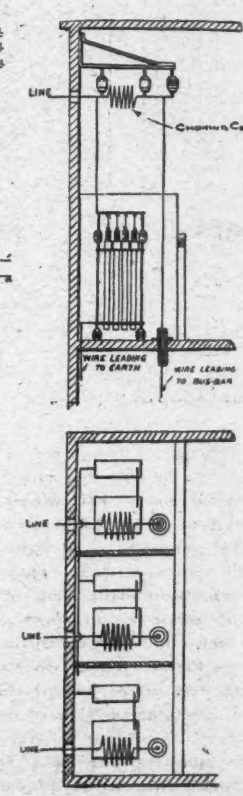


Fig. 7.—Arrangement of Protective Apparatus in Station.

overhead line; (B) the same, with an underground line; (C) the protection of a cable at its junction with an overhead line.

In the first case, steady static charges are removed by the well-known device of a water jet, which, however, owing to its high resistance, cannot cope with impulsive rushes of energy; the Moscicki condensers, which practically earth the line to high-frequency discharges, but are almost impervious to ordinary frequencies, are next in order, and are backed up with inductances which, on the contrary, are impervious only

to high frequencies and do not impede the working currents—these are preferably connected on the line side of the switches. Lastly, the Giles valves are inserted between the switches and the transformers (or generators) to provide a by-pass for slow but heavy surges due to short-circuits or the opening of circuit-breakers—surges which in this case are dangerous only to the transformers, and must be dealt with as shown by means of a device which renders excessive rise of pressure impossible.

In the second case, lightning discharges are not usually to be feared, but heavy surges are particularly dangerous, and may come from either side of the circuit-breakers; a double set of valves, therefore, is required to protect the transformers on the one hand and the cable on the other.

Lastly, at a junction between overhead and underground mains, lightning discharges of high frequency must be kept out of the cable, which is therefore protected with condensers and inductances.

Referring back to fig. 3, where overhead mains leave a sub-station as in case (A), the water jets are seen on the left hand, the condensers in the middle, and the inductance coils on the right. Fig. 7 shows the arrangement of a similar installation in section and plan.

In the foregoing we have not attempted to deal at all exhaustively with the theory of the system described; for further details we refer to an article on the electric valve which we published in our issue of January 8th last, page 51. We have, however, said sufficient to show that the system is embodied in thoroughly practical shape, and it is already being adopted on a large scale. For the reasons we have given, it should be of especial interest to users of high-pressure installations in all countries where lightning discharges are common and violent, such as Canada, South Africa, &c., as well as to the owners of high-pressure underground cable networks everywhere.

The use of the Moscicki condensers for the improvement of the power factor in A.C. systems—a need which is making itself felt more and more insistently—has been explained in the article referred to above (September, 1907); but this, as well as the very widely extended use of these condensers in wireless telegraphy, is beyond the scope of the present article.

ENGINEER REPRESENTATIVES IN THE COLONIES.

By E. KILBURN SCOTT, M.I.E.E.

Out in Australia the English specialist firms miss much business by not being represented, or else represented in an ineffectual way. The best kind of agent for an engineering firm is a qualified engineer having good address and some commercial knowledge. Certainly in Australia the man who can talk to a mine mechanic in the back blocks, and the manager of an electricity works in the city as a fellow engineer, stands the best chance, and especially is this so if the representative can take off his coat and start a piece of machinery going. If he can also get up at an engineering meeting and discuss papers convincingly, then so much the better. Australian engineers dislike being "talked at" by the man who has drifted into his job from a clerkship in a shipping office, or from selling crockery, drapery, &c.; and, furthermore, they don't much care about passing orders to shipping houses that have built up a reputation on, say, the exportation of meat and wool and the importation of furniture and dress goods.

The shipping firm's name, address, and letter heading may look well, and the banker's reference be above suspicion, and yet if its legitimate business is on lines remote from engineering, it is best to let it "stick to its last." The feeling which is engendered by a shipping house suddenly blossoming out as engineers in an Australasian city, is much the same as if W. Whiteley, of London, Lewis, of Manchester, or John Barran, of Leeds, fixed an engineer's plate on their door, and tried to sell steam turbines, dynamos and cables, and tool steel. The genuine engineer in England wouldn't like it, and engineers in Australia don't like it either.

Some specialist English firms have foolishly allowed themselves to be represented in that way, whilst many more are not represented at all. The writer used to inform his Australian friends that the keenest buyers at home, such as the railway stores departments, manufacturers, &c., always purchased engineering and electrical plant from specialist firms, motors from motor manufacturers, starters from a firm making nothing else, arc lamps from a lamp firm, and so on. They saw the point of the argument, but they said, Where are the representatives of your specialist firms? Where are their catalogues and price lists? The writer had to admit that many of our best specialists and most-truly English firms were quite unknown. He tried to rectify it to a small extent by getting out some hundreds of catalogues, and distributing them to his students; but this only went a little way, and the foolish duty on catalogues which was imposed about two years ago put a stop to it.

The question is, how best to bring the names and manufactures of the English specialist firms before buyers in the Colonies? As they are mostly in a small way, and run their businesses to pay, they are therefore unable to have a representative entirely to themselves. Possibly the best way would be for a group of smaller English firms to get together and appoint an engineer who has been out there some years, or who is "native born," to represent them. In Australia there might be one in each State, counting Tasmania with Victoria, and in New Zealand one in the north and one in the south island.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Russian Trade.

I have been much interested in the very excellent series of "Notes on Trade Abroad," and especially the references to Russia. I take particular interest in that country, because a millwright ancestor, James Kilburn, built and equipped one of the first (if not the very first) woollen mills in Russia. I was also out there some 20 years ago.

In the time of Elizabeth and Peter the Great and for long afterwards, England was practically the only country that did any business with Russia, and a visit to Archangel is very interesting, because of the evidences of our trade through that (at one time the only) Russian port.

For miles the banks of the Dwina are practically English soil taken out as ballast by ships, and it is quaint to come across English types bearing names such as Smith and Jones who are so Russianised as not to be able to speak our language.

The first dockyard that Russia had was established for Peter the Great at Archangel by Englishmen, and it would be a pretty safe thing to say that a Tyneside or a Scotch engineer had something to do with nearly all the early ironworks in Russia, and certainly Yorkshiremen started all the woollen mills.

How comes it, then, that the present machinery and engineering trade of Russia and Siberia is so much in the hands of Germans and Belgians? What are our people doing to let Belgians get such a foothold. One can understand the Germans having a "pull" by reason of easy railway communication.

Some years ago I represented a Liége firm in this country, and it came to my notice that Brussels and Liége people had financed and engineered a number of lighting and tramway concessions and started a good many iron and steel works in Russia.

After the Siberian Railway was completed there was a slump, and some of the 100 fr. shares went down to 30 or so, my own company being heavily involved. I met the manager a few weeks ago, and he informed me that the financial strain passed away long ago, and many of the shares are to-day nearer 300 than 100.

E

One odd thing about the matter is that the Belgian firms went into the Russian business with the idea of supplying not only the original but also the extension plant; but it has turned out that the managers of the lighting and tramway companies and the iron and steel works are now buying extension plant wherever they can get it cheap and good.

Of course, the Belgian and German firms always have a "big pull," because their machinery is so much in evidence, and their catalogues and price lists, printed in Russian, are sown broadcast. But it is never too late to mend, and especially at this season when the Russian people really show a friendly disposition, and want to get into closer trade relations.

Our English constitution and freedom are the ideals which the people and their representatives in the Duma have in their mind to copy. I had a chat with two Russian engineers a few weeks ago who had come over specially to get into touch with manufacturers on this side, and they pointed out that one result of the new *régime* will be less restriction on the Press.

Before very long Russia, which has now only a few newspapers of the Government *Gazette* type, will have many more newspapers, and it is to England that the proprietors will look for printing machines, and the motor equipments for driving them.

Now the question is, are the English firms alive to the situation, have any of them sales engineers on the road looking up business, is there a single electrical firm in England, other than the Westinghouse Co., which has issued catalogues and price lists in Russian, and if not, why not?

If Englishmen were as well informed about Russian trade as they are about the sensational political events, they would not be so badly off, and that is why your "Trade Notes" are so valuable. The daily Press only retails stories which gives as wrong an impression of Russia, as say the sensational English news in an average American paper gives of English life.

Russia is a great country, and the Russians are amongst the most virile of the world. If all the nations of Europe were to invade Russia in turn they would make practically no impression. It is the least vulnerable of any country; it is the furthest from that bugbear of good business—Socialism—it is a great country to trade with.

The possibilities of trade depend primarily on population and revenue, and here are a few figures which show Russia in very good light:—

	Area.	*Population.*	*Revenue.*
Great Britain and Ireland ...	121,380	43,200,000	£145,000,000
Russia	8,400,000	130,000,000	£210,000,000
German Empire	208,850	56,500,000	£109,000,000
India	1,770,000	300,000,000	£85,000,000
China	1,500,000	400,000,000	£15,000,000
United States	3,623,000	84,000,000	£146,000,000

Germany and the United States are protected against us by tariffs and high industrial development. India and China have immense populations, but the people have few wants, and they are far away. Russia, with many wants, an immense population, and the highest revenue of any country, is at our doors.

I ask, again, how many English electrical firms have sales engineers on the road in Russia, and have catalogues and price lists in the language of that country?

E. Kilburn Scott.

Carbon Brushes.

Referring to the letter in your last issue, I may say I was for nearly two years the chief technical representative of a firm of carbon brush manufacturers with a world-wide reputation, and during that time I think I came into personal contact with nearly every designer of direct-current machinery and almost every central station engineer in this country. The one thing that struck me most was how little attention was paid to the subject of carbon brushes, particularly by central station engineers. It was quite a common thing to be told carbon was carbon, suggesting that there could be but little difference between various brushes, but when I replied that metal was metal, and then asked why people were so foolish as to use copper instead of iron, it began to dawn that there was more in the subject than seemed to be at first sight; and when I told some of my friends there was a range of carbon brushes from samples with a current density of 20 amperes per square inch to samples with a current density of 150 amperes per square inch it set them thinking furiously, particularly when the unsatisfactory working of some generator or motor was recalled.

The subject of carbon brushes is not a very difficult one, but, unfortunately, no definite rules can be laid down, and experience alone must be the guide in the final selection. Carbon brushes have two functions to carry out; they must be able to carry the main current with as little loss as possible, and they must stop the current in the short-circuited coil by just having sufficient resistance to do so. Granted that these two conditions are fulfilled and there are no mechanical troubles caused by vibration and faulty brush-holders, it will be found commutation will be satisfactory in nearly every case.

The great point to be remembered in selecting carbon brushes is to get those with just sufficient resistance to stop the current in the short-circuited coil and as it is impossible to measure either the current in the coil or the reactance voltage in a commercial manner, it will be immediately seen how impossible it is to lay down any fixed rules. Some machines have very high reactance voltages, some low, depending more or less on their working voltages, and in every case the correct brushes will just have sufficient resistance to stop the current in the short-circuited coil. If a brush of too low resistance is used, burning at the contact surface will be the result, accompanied by heating and sparking, while if a brush of too high resistance is used, a greater number must be employed, as the higher the resistance, the less current it will carry, and consequently the size of the commutator and brush gear will have to be increased. Once carbon of the correct resistance is found, principally by the trial and error method, it is only then a question of employing a sufficient number, so that the carbon is working at its correct current density, which is generally well known for each brand.

On the above lines it will be easy to explain why brushes may work well for periods even as long as 10 years, and in other cases why some will not work satisfactorily on any consideration.

Sarsfield W. Martyn.

London, N.W.

Electric Miners' Lamps.

Referring to Mr. Giraldus Jones's letter in your present issue, I understand it to be the "retort courteous" because the colliery data he expected were not forthcoming.

As previously stated, I greatly regret that I am not allowed to publish the details of the costs referred to, but have written to another colliery for sanction to submit the results obtained at their installation. If I obtain permission, I shall be pleased to send the same to you, when, if you think the subject still of sufficient interest to your readers, you may kindly find room for the same.

I thank you, Sirs, for your courtesy in admitting my letters to your columns, but wish to add that, although no one begrudges Mr. Jones the personal advertisement contained in the last clause of his letter, it should, in justice to myself, be made clear that Mr. Jones and I have not been in touch for about nine years, hence his somewhat airy deprecation of my figures, and his assumption that he has had a *more extended experience* than I have had, cannot be based upon definite knowledge on his part, and may not accord with facts.

Fred. J. Turquand.

London, W.C., *September 27th*, 1909.

Not Wanted in Australia.

I think you would be doing a kindness to the many readers of the REVIEW if you would make known the true state of affairs in Australia at the present time.

Scores of engineers are coming out here owing to misrepresentation of the real facts about employment, and on

arrival here they find that it is just as difficult to get work as at home—in fact, more so.

Also it is more expensive to travel from one of the few towns to another, the distances being very much greater.

All the men that I have met here complain that they have been "had" by the glowing accounts they heard at home of Australia.

The legislation of this country is so framed that it prevents any new-comer from taking positions such as mine manager, borough engineer, mine electrician, and so on.

And if a man would and could fill in some time in any of the few shops, in the capacity of a fitter or machinist, &c., he cannot do so, on account of the trade unions, which practically run this country.

If he should get a start he is soon got rid of, if he refuses to join the union and become one of the crowd under the heel of union tyranny.

To sum up, it is much more pleasant and far cheaper to be out of employment at home than in Australia.

This letter must not be taken as the grumbling of a disappointed engineer, or one isolated case, as, personally, I am told I have been more fortunate than the majority.

Milli-Volt.

Sydney, N.S.W., *September 29th*, 1909.

Prospects in Chile.

Might I ask if any of your readers could give me some information as to the prospects of finding work in Chile? Would they be inclined to advise a young engineer with a knowledge of the Spanish language and plenty of grit in him, to go out, say, to Santiago on "spec.," having left on landing only sufficient money to keep him for a few weeks? Would he be likely to find work soon, and if willing to rough it at the start, till he was thoroughly familiar with the language and ways of the country, would there be a higher prospect before him than there is in this country for a poor shift engineer without influence?

Desalentada.

[An article on "Life in Chile" was published in our issue of July 23rd, 1909, p. 157. Another reader wishes for information as to the cost and conditions of living in Rio de Janeiro. Much information regarding commercial and social conditions in Brazil was given in a lengthy article in two instalments, in our issues of April 2nd, p. 571, and June 4th, p. 944, this year.—Eds. E.R.]

Tramway Contributions to Rates.

In your editorial of the current week you remark that the L.C.C. tramways have made no contributions to the rates since they have been worked by the Council. The writer was evidently thinking only of contributions from net profits. The tramways, however, contribute very heavily as ratepayers, not only on their buildings, &c., but also on the permanent way. In the year ending March 31st, 1907, rates on permanent way totalled £40,299, and they are still higher in the two years since, for which I have not the figures at hand. These payments and the maintenance of the track paving are, together, a very heavy subsidy to the rates. No other users of the public highway are subjected to such a toll, and so far from the London tramways being "on the rates," as is frequently asserted, it is the motor-omnibuses, cabs, carriers, and other great users of the highways who are actually "on the rates" as regards the maintenance of that essential part of the plant they employ.

The magnitude of these charges is not insignificant. A few years ago the accounts of the largest omnibus and the largest tramway company in London—both worked by horses at that time—showed the following contrast:—

	Omnibus Co.		Tramway Co.	
	Per vehicle mile.	Per passenger.	Per vehicle mile.	Per passenger.
Rates and taxes ...	0·103d.	0·015d.	0·678d.	0·070d.
Road maintenance ...	—	—	0·581d.	0·060d.
Total ...	0·103d.	0·015d.	1·259d.	0·130d.

Rates and taxes not being separately stated in the accounts, the ratio of rate payments was really greater than appears from the above figures. The totals, however, represented one-sixth of the total working costs for the tramway, and one-seventy-eighth part of the total for the omnibuses. Even with the new petrol tax the difference now can be little or no less. One principle of English highway law, I am told, is that the King's highway is free to all wayfarers, at the expense of the ratepayers, whose duty it is to maintain it in passable condition. It is not free, in fact, to the tramway passenger, who by the anomalies created by applying Elizabethan rating law to modern conditions, and horse tramway law to electric traction, is obliged to contribute to the maintenance of the streets for other users.

It may be right that users should pay; if so, all users should pay *pro rata*. It may be right that the use of the highways should be free; if so, it should be free to all users. That one class only should be charged and none of the others cannot be right on any principle.

Henry M. Sayers.

London, S.W., *September 25th*, 1909.

The Newfoundland Cable Dispute.

As there are some inaccuracies in the editorial in your issue of August 20th last entitled "The Newfoundland Cable Dispute," we feel sure that the editorial was written without your being in possession of the facts.

In the first place, you state that the Commercial Cable Co. has already secured a landing at Port aux Basque for a cable to Canso. We would correct you in this by stating that the Newfoundland Government owns the cable between Port aux Basque and Canso, and, therefore, the Commercial Cable Co. has no landing at Port aux Basque.

In the next place you refer to the Commercial Cable Co. as having "a monopoly of cable traffic passing over the Newfoundland Government lines for a period of 25 years." The contract you refer to as a monopoly is nothing more or less than the usual traffic contract between connecting cable and telegraph lines, and in this case is merely an extension of a prior contract between the Newfoundland Government and the Commercial Cable Co. The Anglo Co. has its own landline system in Newfoundland, and its own cable system to Europe and America. The Newfoundland Government also has its own landline system in Newfoundland, *but no cable connection with Europe and America*; and so it made the above-mentioned traffic contracts with the Commercial Cable Co. Hence your statement that the Commercial Cable Co. is given a monopoly is misleading. The Commercial Cable Co. merely enabled the Newfoundland Government to compete with the Anglo Co., and break up the Anglo's monopoly of the cable traffic.

You state it cannot be unreasonable to permit persons or corporations to compete on an equal footing, inferring thereby that the Commercial Cable Co. has all the advantage. The answer to this is the same as above, namely, that the Newfoundland Government landlines joined to the Commercial Cable Co.'s ocean lines compete with the Anglo Co.'s system of Newfoundland landlines and ocean cable lines. In fact, so far from the Commercial Cable Co. having an advantage in Newfoundland, it is not allowed to compete with the Anglo on an equal footing, inasmuch as the Commercial Cable Co. is prohibited by its contract with the Newfoundland Government from soliciting, receiving or delivering cable messages in Newfoundland. The Anglo Co., on the contrary, always has done this, and is still doing it.

The Anglo Co. has upwards of 500 miles of its own landline in Newfoundland, while the Commercial Cable Co. has none, nor is it allowed to have any.

The statement that by the making of the traffic, repeat traffic, contract between the Newfoundland Government and the Commercial Cable Co., the Anglo Co. is not allowed to compete on an equal footing is absurd in view of the above-mentioned facts.

You state that the Atlantic companies enjoy *practically* equal conditions of working in Great Britain. In reply to this, we would point out that the Atlantic companies enjoy *actually* equal conditions of working in the United States.

We have already made a complete answer to all that the Premier of Newfoundland has stated in his public interviews. We would, however, refer to the statement on page

804 of your journal of the same issue in which your editorial appears, where it is stated that the Government has given them (the Commercial Cable Co.) the land they required. In reply to this, we would say that we made repeated applications to Sir Edward Morris's Government for the grant of land called for by the contract, but without success, until the granting of the land was too late. We could not take the risk of not having the cable building and trench, &c., ready for the arrival of the cable-ship, and so we had to lease a piece of land on which to construct the cable building and bury the shore ends, and the cable is now landed on, and operated from, that land leased from a Newfoundland citizen.

We think in fairness that the foregoing is entitled to the same prominence as was given to your editorial. We especially think so because there is one fact with which neither you nor the general public are familiar, namely, that nearly twice as much English and Canadian money is invested in the securities of the Commercial Cable Co. and the Mackay Companies, at present market values, as is invested in the Anglo-American Telegraph Co. at present market values, even if it be assumed that all the securities of the Anglo-American Telegraph Co. are held by English and Canadian investors, and yet several London newspapers have stated that the contract in controversy between the Newfoundland Government and the Commercial Cable Co. is prejudicial to the interests of British capital without knowing or realising the large amount of English and Canadian money invested in this Commercial Cable system.

Commercial Cable Co.

Fred. Ward, *Manager in England.*

London, E.C., *September 27th*, 1909.

Unemployment.

Several letters have recently appeared in your valuable paper *re* unemployment, and one refers to attempts made last year to organise the station engineers, electricians, draughtsmen, &c., engaged in this country. This is true, and you probably remember me under the *nom de plume* of "Organiser." The scheme entirely failed, and two influential engineers who backed it were disheartened by results. It is impossible to organise those engaged in the electrical profession in this country, and time and money have been lost in trying to do so. Young men having rich parents work for nothing, the station superintendent is jealous of the shift engineer, the draughtsman at 25s. per week considers himself superior to the foreman at £3 per week, and so on. Jealousy and so-called respectability absolutely prevent combination, consequently you can buy a first-class technical man at 30s. per week, and the whole spirit underlying the profession appears to be "please may I be allowed to breathe." I was disgusted with the results. In America many electricians are earning three times the money paid here, owing to the "brotherhood" regulating wages, and not competition. Until my *confrères* in the electrical profession learn from bitter experience to toe the line with the rest of the world's organised workers, and quit their smug respectability, we shall still have high-grade, technical, educated engineers working for the wages of a navvy, and influence and favouritism surpassing brains and experience.

The chaotic state of the whole electrical profession is heart-breaking. An attempt was made last year to remedy this evil, thanks to the assistance of your paper. This attempt failed, owing to lack of adequate support, therefore those who complain have only themselves to thank.

Organiser.

The letter of "Electricity Supply" under the heading "Unemployment" in your issue of 24th inst., seems to refer to the correspondence which appeared some months ago in your paper under the title "Proposed Engineers' Association."

"Electricity Supply" says he has "reason to know the matter has dropped." Will you kindly correct this idea, as I have been in communication with the whole of those who sent in their names in connection with the "Proposed Engineers' Association," and in the course of a month they will have certain literature placed before them, as has already been promised.

Status.

Magnetising Current of an Induction Motor.

The current taken by an induction motor is composed of two components:—

1. The energy current, which performs useful work, and varies in proportion to the output of the motor.

2. The idle magnetising current, which is 90° out of phase with the energy component and performs no useful work; this idle current is approximately constant at all loads.

If the motor is run without load at normal voltage and readings are taken of the watts and volt-amperes input, the magnetising current can be calculated by either of the following methods:—

(*a*) The no-load power factor $\cos\phi = \frac{\text{watts}}{\text{volt-amperes}}$, and the magnetising current = no-load current × sine ϕ.

(*b*) Magnetising current $= \sqrt{\text{Total current}^2 - \text{energy current}^2}$, the energy current being $= \frac{\text{watts}}{\text{applied volts}}$.

The 15 amps. observed by "Troubled" would not represent the true magnetising current, as part of it would be energy current overcoming hysteresis and eddy-current losses; these could be separated as above if the watts and volt-amperes were taken, but in this case each quantity would be less than above on account of the rotor being open-circuited and at a standstill.

The losses in an induction motor are—

(*a*) Copper losses in the stator and rotor windings.
(*b*) Friction and windage losses.
(*c*) Stator iron losses.
(*d*) Rotor iron losses.

(*a*) The copper losses increase in proportion to the square of the current taken by the motor, and could be determined as follows:—

Clamp the rotor so that it is unable to rotate, and apply a low voltage to the stator windings, the rotor being short-circuited; then the power taken will be practically all copper losses in the two windings. If sufficient voltage is applied to give full-load current, then the wattmeter will show the full-load copper losses of the machine.

(*b*) The friction and windage losses depend practically on the speed, so may be taken as constant.

(*c*) The stator iron losses are independent of the load, as they depend on the saturation of the iron and the magnetic changes.

(*d*) The rotor iron losses are proportional to the slip, therefore there is very little increase up to full load, and for all practical purposes they can be considered constant.

The losses (*b*), (*c*) and (*d*) will be given by the no-load test, as the power taken will be nearly all due to iron and friction losses, excepting a small portion which will be due to copper losses; this should be subtracted from the wattmeter reading to give the true iron and friction losses.

I trust the above will be of service to "Troubled"; of course, the results obtained will not be sufficiently accurate for experimental purposes, but will do very well for an ordinary workshop test.

W. D.

What is an Electrician?

Referring to the correspondence in your issues of September 10th and 17th, *re* above, this matter was of interest to me, inasmuch as in the number of your paper in which this question was raised, I had an advertisement for an electrician, and it may be interesting to the applicants to know the number and class of men who evidently consider themselves entitled to be styled electricians.

In the first place, I may say that I fully agree with the editorial definition of an electrician, and the man who has had the training and experience mentioned therein is the man suitable for the post advertised.

The number of applications received was 170, and they were made up as follows :—

Electricians (as above) who have had charge of a works' plant	26
Manufacturing engineers' erectors or workmen (one of these being a B.Sc.)	34
Central station men	30
Wiring contractors' men...	32
Men in charge of hotel or private house lighting ...	12
Men who obviously had written on the "off chance"	28
Wiring contractors who wish to give up their business for a permanent job	8
Total =	170

In selecting a man for any given position, there is no doubt that much depends on the manner in which the application is written, and probably many a good man has missed a situation by the ill construction of his letter, and certainly in the present instance—even taking into consideration the moderate wage offered and the class of men likely to be attracted—many of the letters condemned the applicant at once. A good number of applications were written on odd pieces of paper torn out of copy or memorandum books, and these from men in apparently steady work. I can understand that to men out of work, the cost of notepaper even is a consideration, but I think it would be well if, when they were in work, they would think of the time when their job would be finished, and lay in a little stock of suitable paper and envelopes for future applications. Perhaps some will think that this is of trifling importance, but in these days nothing which will forward the chance of obtaining a job should be neglected.

Five of the applications—one of them from apparently a suitable man—were so badly written that the address and/or the signature could not be deciphered, and life is too short for spending a lot of time in studying handwriting of this sort.

A question which has often been put to me is :—"Is it of any advantage to enclose a stamped addressed envelope?" Personally, I do not think it is, for if an employer considers an applicant is likely to suit him, he will not object to spending a penny on a stamp; on the other hand, I know from personal experience that one does not always receive a reply by enclosing a stamped addressed envelope. In the present instance six applicants enclosed stamped envelopes, and these have been posted.

It was a matter for surprise to find that in spite of the notice at the head of the "Situations Vacant" column, no less than four enclosed original testimonials. This is a very risky thing to do, for originals are likely to be mistaken for copies, and, in the case of unsuitable applications, subsequently destroyed. I might mention that each of the four omitted to enclose a stamped addressed envelope for the return of their papers. They have, however, been posted.

Two young fellows, both of whom are employed in the stations of different power companies, stated that "they were not afraid of the juice"; and while I do not altogether disbelieve them, I am afraid the statement would not be taken as a recommendation. The Employers' Liability Act is a serious matter, and one cannot afford to engage persons who profess not to have much respect for voltage.

In conclusion, I would advise men who are applying for situations of the class indicated above to write their applications on foolscap paper, and to write on one side only. True, foolscap is usually sold at ½d. per sheet, but for this purpose it is worth it.

W. H. B.

September 27th, 1909.

The Measurement of the Insulation Resistance of a Live Three-wire System.

In your issue of the 17th inst. Mr. Stuart A. Russell described Prof. Rousseau's method of obtaining the separate values of the three components in the combined insulation resistance of a three-wire network to earth.

I have employed this test personally on several occasions, but have not found it satisfactory except during periods of *very* light load. The variable results obtained at other times have been due, I think, to the unreliability of the assumed ratio of the voltage of one side of the system to that of the other. It does not necessarily follow that, because a certain ratio exists between the voltages at the central station, for example, this ratio is a constant throughout the system. I have found on several occasions when testing that the neutral has had a positive potential to earth at one point, and at the *same* time a negative potential to earth at another point of the system.

Referring to his formula for obtaining the combined insulation resistance to earth of a live system, Mr. Russell states—"This method can be applied at any point of the system, and it is not necessary to interrupt the earthing connection when making the test, &c.," but he omits to point out that if the earthing connection be not interrupted during the test, the result obtained will be the combined insulation resistance of the network and the earthing connection in parallel with it. Mr. Russell probably thought that the necessary correction was obvious, and for the moment forgot that a mains engineer is often too busy to verify the formulæ he may wish to employ.

Daniel Shirt.

Birmingham, *September 27th*, 1909.

Electric Laundry Irons with Indicators.

With reference to your correspondent's letter from Adelaide on the above matter, we think that the plan we have adopted in this connection (which was shown by us at the Franco-British Exhibition last year) would probably meet the case.

Our experience is that the best point from which to feed electric irons is overhead, and not from a wall-socket at table level. We therefore arrange a ceiling rose with a ceiling switch alongside, operated by two cords hanging at a convenient height over the centre of the ironing table, with a small red lamp connected in parallel with the ceiling rose, so that this is always alight when the switch is turned on and the iron in circuit. A light spiral spring attached to the flexible cord serves to take up the slack and enables the furthest corners of the ironing table to be reached by the iron, with an entire absence of any slack flexible in any position. The red lamp need only be a 5-c.p. lamp, and can be under-run to the extent of some 20 per cent. or 30 per cent., in which case the current consumption is quite trifling and the life of the lamp exceedingly prolonged. This removes any possible objection from the supply authority on the score of obtaining light from the heating circuit. We have found this plan answer admirably in practice.

Rashleigh Phipps & Co.

London, W., *September 28th*, 1909.

Water-Power Development.

I was interested to see in your last issue the statement that orders for large water-power plant for Canada had been secured by Messrs. Jens Orten-Böving & Co., the bulk of which they would have manufactured in Sweden.

But your remarks in "Notes on Trade Abroad" might lead your readers to infer that there are no "hydraulic specialists" in this country, with the exception of imported Continental engineers, which, to say the least of it, is hardly correct.

Water-power engineering has been carried on in Britain by a number of firms for 50 years; some of these firms in the North of England and Scotland have most successfully designed and constructed water-power plants, and although most of these are not nowadays considered large as compared with what you described, they require nearly as much technical knowledge and experience to carry out; and, therefore, the designers are entitled to be called "hydraulic specialists."

It seems a great pity to me that you should publish a statement that if any water-power development work has to be designed or carried out in this country, it is necessary to import foreign engineers to do so.

My own firm certainly claim to be "British hydraulic specialists," as they have for years past devoted special attention to the design and construction of plant of this nature, and have carried through a number of good-sized contracts in which the whole of the work was designed by

Englishmen, a very considerable portion manufactured in the British Isles, and only certain portions, which at the present time it is nearly impossible to get manufactured in this country, have been purchased abroad.

In one case I supplied a 3,000-B.H.P. unit for direct coupling to A.C. generator, complete with steel pipe line, expansion joints, and all usual accessories, which has been installed abroad as an extension to a Continentally designed and constructed power station, and the reports which I have received regarding the working of this plant, in comparison with the existing Continental sets, conclusively prove that the successful design of water-power plant is not exclusively confined to foreign engineers.

James Gordon, A.M.I.M.E.

London, E.C., *September 28th*, 1909.

[We can only imagine that our correspondent has not carefully read—if at all—our comments on "Hydro-Electric Possibilities" in "Notes on Trade Abroad" (see ELECTRICAL REVIEW, September 3rd). We think that careful reference to these will show that he is labouring under a misapprehension as to what we have said. We quoted our "visitor's" remarks as showing the impression that is held by some engineers at home and by authorities abroad who have the placing of business in their hands. We never have shut our eyes to the achievements of home manufacturers of hydraulic plant; indeed, we referred to these in the course of our article, and said that we British engineers "must not let it be imagined that we are by no means ignorant of hydro-electric engineering matters." Does Mr. Gordon desire to hold editors responsible for opinions expressed by their correspondents?—EDS.]

Testing Condensers for Leakage.

I do not wish to discourage a newcomer to our profession, and should have left "Harbee's" letter unanswered, but for the fear that it might mislead some of our younger engineers. Let me, therefore, briefly point out that the effect of a given quantity of salt water passing into a bank of boilers with the feed water, depends chiefly on three conditions of service: the class of boiler, the nature of the load, and the rate of evaporation.

I have in my own experience found the maximum allowable amount of salt per gallon in the boiler to vary 1,000 per cent., from 200 to 2,000 grains per gallon, the worst conditions being when water-tube boilers with a very small steam disengaging surface and capacity have to supply a heavy and fluctuating load.

In such circumstances, I have found that the lesser quantity mentioned above is sufficient to cause violent priming. I can assure "Harbee" that it does not take "a good sized gap" to pass enough salt water in half an hour to bring the density in the boilers up to this limit. As a matter of fact, I have found that a hole of $\frac{1}{4}$ in. diameter in a single tube will do it, and such a hole will occasionally show up suddenly through the tube becoming thin and then bursting through.

Such a gap will not need a chemical test to locate it (as "Harbee" rightly claims) but it will show itself up in a most unpleasant fashion. It is, however, advisable to adopt some less clumsy method of detection.

In conclusion, let me beg "Harbee" to remember that in engineering, as elsewhere, "circumstances alter cases."

R. Somerville Bayntun, A.M.I.C.E., &c.

Mersey Railway Power Station, Birkenhead,
September 28th, 1909.

Views on a Review.

May I be permitted to make a few remarks in reference to a—I will not say *your*—criticism on Mr. Ibbetson's little book?

The reviewer avails himself freely of his opportunity of using the majestic or editorial plural in order to lend weight to his remarks, but, not content to hide his light permanently under a bushel, condescends to sign his initials—perhaps not caring to adorn his lucubration with his full name. I should like to suggest, with all due deference, that his—I apologise—their views on prefaces affect the value of a book not at all, and are of little interest to readers apart from their recognition of the possible existence of "a friendly and competent reviewer," while the quotation is a very dangerous one to use. It has a nasty spike at both ends. The remarks on the book itself are a series of brief commendations of whole chapters at a time mixed with lengthy exposures of generally minor errors, some of which are probably undetected compositors' mistakes, and not one is likely to seriously mislead.

Take, for example, the reference to page 97: "The golden flame . . . is due to vapours . . . produced by the heat of the arc." Does your critic infer that the vapours are *not* produced by the heat of the arc? Does he wilfully or ignorantly misread the sentence? Or is he merely splitting hairs about "Terminological inexactitudes?"

If your reviewer should be unfortunate enough to stop a boot travelling at a somewhat high speed, would he be understood if he stated that the resulting discoloration and aggrieved state of mind were produced by the kick, or would he think it necessary to talk about "congested capillaries," "nervous impulses," &c., connecting cause and effect?

True, there *are* "more things mixed than flame arcs" (pretty phrase), and vapouring is not their monopoly.

C.C. joints! Yes, I have had to deal with these "high-speed" joints, after erection, too. Like the steel, they may work hot, but woe unto them when in damp places, and woe unto the man in charge. There are joints and joints, just as there are competent as well as carping critics.

There is very great need of a book, in less than three volumes, dealing with the subject in question, and the writer, in common with many others, has welcomed Mr. Ibbetson's little work, and this in spite of its faults. May there soon be a second edition with these rectified.

Readers of the ELECTRICAL REVIEW are used to seeing fair criticisms, but one cannot feel that this book has been dealt with in an impartial or even fair, let alone friendly, manner.

Fair Play.

[While the taste of our correspondent's remarks might be criticised, we will content ourselves with pointing out that his quotation regarding the flame arc, by omitting words essential to the point made by our reviewer, completely begs the question. We have satisfied ourselves that the review is fair, while we are certain that the reviewer was not actuated by malice; of his competence there can be no question.—EDS. E.R.]

Tramway Power Tariffs.

As to whether the assumptions in my comparison of Glasgow and Manchester traction costs are questionable, I am quite content to leave unbiased readers to judge.

You say I increased the Glasgow loan charges to a hypothetical amount. Quite so. The hypothesis, however, was based on a sure foundation. Glasgow obtained a longer term than Manchester for repayment of debt. Is then the caprice of Government departments in sanctioning loans not to be taken into account in comparing costs, when those costs include loan redemption charges?

Further on you state that I make no allowance for overhead equipment at Glasgow. You are in error. The capital outlay taken from Glasgow's accounts (page 24) is obviously exclusive, and properly so, of overhead equipment, which, in towns like Manchester, is found by the Tramways Committees. Proof of this can readily be seen in the detailed statement of capital account.

Regarding your remarks on rates, &c., I quite admit that Scottish undertakings generally pay more, proportionately, in rates than English undertakings. The allocation in Glasgow, however, as between generation and distribution on the one hand and tramway operation on the other, is so glaringly incorrect, apart from percentages on capital, that it is a waste of time to pursue this further.

Again, I fail to see that there has been a "significant silence" as to the traction proportion of Manchester's depreciation. In your earlier comments you said definitely there was no counterpart in Manchester to Glasgow's provision for depreciation. Now that you are shown to be incorrect on this point, you still throw doubt on the allocation as between lighting and traction.

I feel compelled to say that the accounts rendered against the Manchester Tramways Committee have always, and

particularly in recent years, been subjected to very searching examination, notably by the general manager, who thought that Manchester might possibly have done better with a separate traction station. At last, however, after exhaustive discussion they were fully convinced that combination had been justified. Facts and figures were produced to an extent which is impossible in a newspaper controversy, and I submit that in the case of Manchester the tramway manager is of necessity a better judge of the questions discussed than anyone can possibly be writing away from the locale.

Finally, I note that you make no rejoinder to my comment on your assumption of costs being equal, despite differences in physical conditions, financial policies, &c.

Mr. Yerbury, in his comments on tramway power tariffs, completely misses the point at issue. He says my observations respecting Sheffield's costs may be open to incorrect interpretation, and he somewhat irrelevantly notes that Sheffield's accounts are drawn up in the standard form. That is not disputed. Whether I have brought Manchester's costs down to Sheffield's basis, or raised Sheffield's to that of Manchester, is immaterial, provided that I use the correct data for making an equitable comparison. As it is shown below that there are certain omissions from the Sheffield basis, I consider the truer comparison is obtained by bringing Sheffield into line with Manchester. The point is that the latter's charge for traction energy in the Bloom Street area (this being the area fairly comparable with Sheffield) is on the basis of inclusion of all charges incidental thereto, and is for net quantity delivered, whereas Sheffield's accounts, as published, do not, according to Mr. Fearnley, the general manager, include all items corresponding to those in Manchester, and they further show that Sheffield's cost is not calculated on the net quantity delivered, the figure used as a divisor being the gross quantity generated.

To particularise, Sheffield's cost for the year, 1908, as published, amounted to £36,730, and to these, for comparison with Manchester, must be added (1) local rates on ducts, feeders, cable, &c., £1,547, and (2) income-tax, £418 (both as estimated by Mr. Fearnley), £1,965; making a grand total of £38,695.

On the exclusion of items (1) and (2) from the published costs I offer no comment, but insist that if included in Manchester's charge they ought, during comparison, to be put against the Sheffield costs, instead of being left against the general operating expenses of the tramways. Having now arrived at a total expenditure, it is necessary to put the quantities of energy in Manchester and Sheffield on a common basis.

Manchester sells current at the D.C. traction bus-bars, and its Bloom Street area is so compact that the losses in transmission do not exceed 6 per cent., whereas Mr. Fearnley puts the Sheffield figure at 10 to 12 per cent.

The total units generated in Sheffield during the year 1908 were 13,192,575, and the units used in works were 1,003,714. The units lost in transmission in Sheffield over and above those in Manchester's Bloom Street area were, say, 6 per cent., or 791,554. Adding these together we have 1,795,268, which taken from the gross quantity generated leave a figure, comparable with Manchester, of 11,397,307.

Dividing the above-named total cost of £38,695 by the 11 million odd units just shown, we have a cost of ·81d. per unit, instead of the oft-quoted figure of ·668d.

Mr. Yerbury's remark as to Sheffield's costs being raised arbitrarily, according to my own judgment, is pointless, seeing that I have merely taken published data, and supplemented that by further data kindly given by his own general manager.

Surely both parties to this discussion are anxious to arrive at the truth, and when it is known that the proportion for rates and taxes shown in Sheffield's costs does not include certain items clearly attributable to power supply, then such items ought for fair comparison to be admitted at once. Also, if, in one case, gross generated figures are used, and in the other net figures, no valid reason can be given against putting them into line.

As to the subject-matter of Mr. Yerbury's forthcoming paper, which will, no doubt, be both interesting and helpful, I will only say that there is nothing debatable in the inclusion of such items as Sheffield's rates on ducts, cables, &c.

S. L. Pearce.

Manchester, *September 27th*, 1909.

[While it is clear that we shall not agree with Mr. Pearce's system of comparison between the Manchester and Glasgow tramways power costs, nor that the Manchester tramways undertaking could not have produced energy since 1902 more cheaply than it has purchased it—everything considered—other matters arise which directly affect the points raised in our original article.

Manchester, with its 67 million units output, its 40,000 KW. of plant in large and economical sets, its all day and all night power load, cannot apparently afford to supply traction energy on a 32 per cent. load factor at less than 1d. per unit.

Mr. Lewis Slattery, of Oldham, in a report of November, 1908 (when the prices were somewhat higher) included two tables, which we reproduce below; one shows the terms on which towns in the neighbourhood of Manchester were supplying much smaller quantities on worse load factors; the other gives some statistics regarding tramway undertakings having their own power plants.

Tramway Undertakings within a radius of, say, 30 miles of Oldham supplied by combined Lighting and Traction Stations.

Town.	Price paid per B.O.T. unit.	Gross annual consumption.	Load factor.	Feeder cables belong to and maintained by
Ashton ...	1·25d.	622,913	—	Tramways Dept
Bury ...	1·00d.	2,639,874	21 %	Tramways Dept
Bolton ...	1·10d.	4,110,085	26 %	Tramways Dept
Burnley ...	1·25d.	2,485,800	24·51 %	Electricity Dept
Blackburn ...	1·40d.	2,023,577	—	Tramways Dept
Halifax ...	1·38d.	3,487,643	18·6 %	Electricity Dept
Manch'ter ...	1·143d.	29,955,070	32·7 %	Electricity Dept
Salford ...	1·30d.	8,575,959	—	Electricity Dept
Stockport ...	1·25d.	2,041,084	26·22 %	Electricity Dept
Rochdale* ...	1·00d.	2,064,318	19·2 %	Tramways Dept
Oldham ...	1·50d.	3,888,404	27 %	Tramways Dept

* For every 100,000 units over 700,000.

Tramway Undertakings having their own Power Stations

Town.	Gross annual consumption.	Works costs.	Total cost inc. estab. charges.	Load factor.
Belfast ...	7,402,175	·70d.	·83d.	21·6 %
Birkenhead ...	2,506,392	·74d.	1·037d.	25·44 %
Bournemouth ...	2,643,399	1·06d.	1·626d.*	—
Cardiff ...	4,470,748	·368d.	·62d.	37·1 %
Glasgow ...	29,150,391	·353d.	1·191d.†	38·3 %
Huddersfield ...	4,097,370	·38d.	·65d.	48 %
Hull	3,617,096	·74d.	·93d.	31·16 %
Leeds	13,231,781	·391d.	·80d.	38·23 %
Leicester ...	5,276,670	·385d.	·628d.	27 %
Preston ...	1,350,828	·384d.	·7d.	52 % approx.
Sheffield ...	12,188,861	·394d.	·668d.	40 %

* High works costs attributable to price paid for and heavy freight charges for coal. † Due to inclusion of £47,500 depreciation.

Mr. Slattery, with an intimate knowledge of Oldham conditions, considered that tramways energy (less than four million units per annum) could be profitably supplied at 1d. per unit, and in view of the tabulated figures given (even though they may not be strictly comparable) one can hardly doubt that there was some justification for his conclusion. Even the Portsmouth tramway plant, using fuel at an average price of 20s. per ton, succeeded last year in supplying 2,590,000 units at ·924d. per unit, inclusive of capital charges.

Mr. Pearce suggests that we ignore the varying conditions of tramway operation; we submit that in the load factor and capital charges these conditions are largely represented. As regards the rating of tramway power plant, we think Mr. Pearce will find that the Glasgow plant is not the only one which can show a comparatively small assessment.—Eds. E.R.]

The Coefficient of Self-Induction.

In your issue of August 6th there appears a review of our book "Vectors and Vector Diagrams," which unfortunately escaped our notice at the time, owing to the holidays. While we do not wish in any sense to call in question the fairness of your reviewer's comments, we think that he has raised one point of considerable importance to electrical engineers, which should not be allowed to remain as an expression of individual opinion only.

We refer to your reviewer's statement that he is unable to accept our treatment of the coefficient of self-induction as outlined by Maxwell, which we have expressed as a complex quantity when it occurs in vector equations. The definition of Maxwell's coefficient, as quoted by your reviewer, is as follows: "That length which, multiplied by half the square of the current in the coil, gives the electromagnetic energy due to that current, stored up in the field." This definition does not appear to us to be inconsistent with the use of a complex number to express the coefficient. For, in the case of an alternating-current circuit in which iron losses affect the value and phase of the current, the ratio between that current and the magnetic flux undoubtedly involves a complex number. By excluding iron losses our form of this coefficient at once reduces to a simple number, as is shown on page 84.

If our view is not correct, it would seem that the use of this coefficient by writers of more importance than ourselves (for instance, Dr. Kapp) has been a mistake, since in ordinary electrical engineering formulæ these writers appear to include in the coefficient the relationship between current and flux. For this reason we think that this matter is of material importance to the electrical engineering profession, and we hope that your reviewer will clear up for us his misgivings on the point.

C. F. Smith,
William Cramp.

Municipal School of Technology,
Manchester, *September 27th*, 1909.

I have read with much interest the above letter. I entirely agree with the authors that the question is one of great importance. Taking warning from the fate of Satni in "False Gods," I must decline the invitation to become an iconoclast. The high priests declare that copper coils near masses of iron have "self-inductance." A "little wisdom" shows that it is practically impossible to calculate this self-inductance. Even if it were possible it would be a far too complicated function of the current to be of any use. "Great wisdom" may show that it is advisable to inculcate a belief amongst youthful electricians in the horrible fetish of a constant self-inductance near masses of iron. If this be the case, I have not yet attained to "great wisdom," and still attempt to teach the young why the assumptions generally made by the priests in order to simplify theory often give results which are approximately true.

I fail to see how the ratio between current and flux can ever be a complex number. If it is, then, surely, either one or both must be imaginary, and if so, why bother about them?

Your Reviewer.

Mining Apparatus.—During the recent session of the Institution of Mining Engineers at Newcastle, a quantity of apparatus designed for use in mines was exhibited. Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, showed their standard safety ironclad switchgear, box-type wrought-ironclad switchgear, the Merz-Price system of protection for cables, and various oil-break switches, gate-end boxes, &c. A demonstration was given of the ignition of a mixture of gas and air in a cast-iron box with wide metal-to-metal flanges, showing that no emission of flame occurred, though a similar experiment with a box having a defective rubber ring joint was shown to result in the ignition of a gassy atmosphere surrounding the box. Mr. T. C. Futers, 26, Cloth Market, Newcastle-on-Tyne, exhibited a portable hand air-compressor used for blowing dust out of the windings, commutator lugs, &c., of dynamos and motors; this consisted of an air reservoir and pump on a wheeled frame, with which a pressure of 15 to 25 lb. per sq. in. could be maintained, with a nozzle having an aperture of $\frac{1}{32}$ in., attached to a 10-ft. length of hose.

THE ENGINEERING SECTION OF THE BRITISH ASSOCIATION AT WINNIPEG.—II.

[BY OUR SPECIAL COMMISSIONER.]

We mentioned in a previous article that a large part of the proceedings were occupied with papers on the working of the grain industry in the Western provinces, and the development of their communications, especially those eastward by water. To make clear our account of this subject, and the bearing on it of these papers, we append a rough sketch map of the country. Canada consists broadly of five sections: A, the Laurentian area; B, the rich Cordilleran region along the Pacific Coast, including the Rocky Mountains to its eastern foothills; C, the district south and east of the great fault which runs through Cabot Strait along the St. Lawrence nearly to Montreal, and then due south through Lake Champlain and the Hudson River to New York; D, the southern promontory of Ontario between Lakes Ontario and Erie on the east, and Huron and the Georgian Bay on the west; E, the great fertile plains lying between A and B which form the provinces of Manitoba, Saskatchewan, and Alberta. To complete the country, the arctic region of tundra and ice should be added, and for administrative purpose the waterways of the St. Lawrence and the lakes, giving water access to the heart of the continent, may be treated as a separate province or department.

Of the above divisions A, called the shield of Canada, is, in the main, an immense wilderness of streams, lakes and forests. It lies all round Hudson's Bay as a centre, and is bounded by a chain of great waters, Baffin's Bay, the Gulf of St. Lawrence, the great lakes, Winnipeg, Athabasca, and the great Slave and Bear Lakes to the Arctic Ocean. It has been swept bare of all recent deposits by glacier ice, leaving vast areas of iceworn Laurentian rocks, and masses of moraine, except where beds of later Archæan or Palæozoic deposits remain over the Laurentian, or igneous rocks have been extruded from below. The principal localities where beds later than the Laurentian rocks remain, and the soil is cultivable though not highly fertile, are in the region round Cobalt, the district S.W. of Hudson's Bay, and that along the north shores of the Upper St. Lawrence and Lake Ontario.

Section B is a mountainous region 350-400 miles wide along the whole of the Pacific Coast, continued southwards through the United States and northwards into Yukon. The valleys and Pacific shore are highly fertile, and the hills contain great mineral wealth. It will become an important market and exporting base for the agricultural products of the wheat growing country.

With Sections C and D we are not immediately concerned.

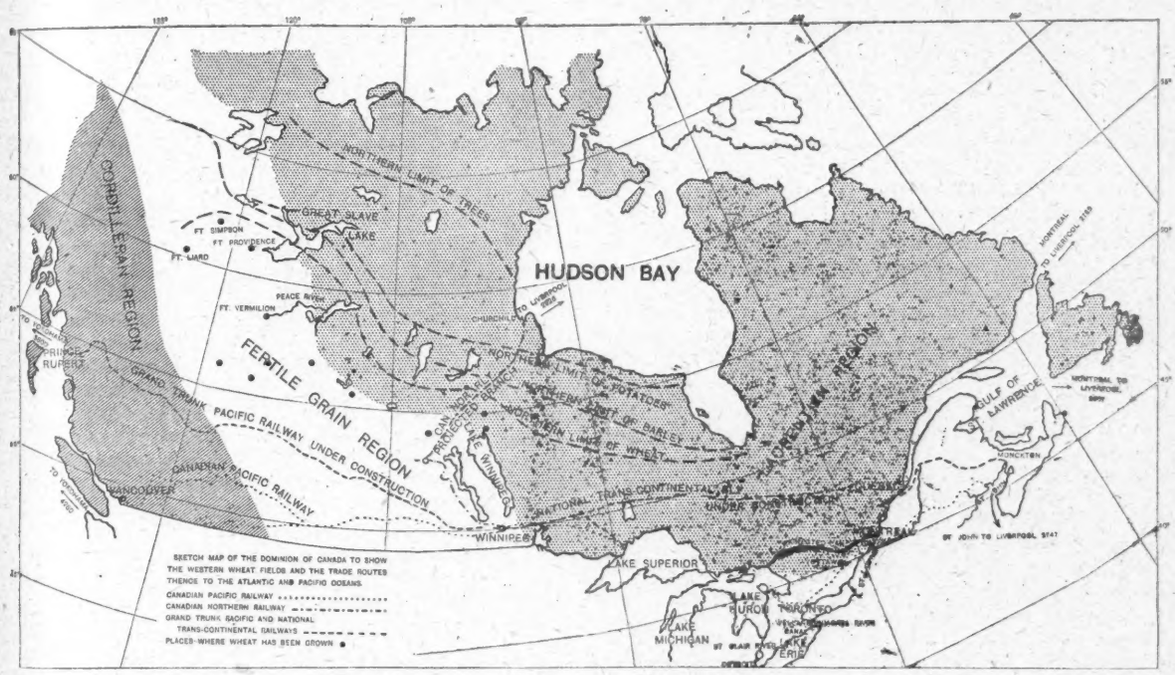
Section E contains the three provinces of Manitoba, Saskatchewan and Alberta, whose wealth and rapid development are occupying so much attention. Geographically, this section is the northern part of the great central plain whose southern part is the valley of the Mississippi, deposited in the Mesozoic period by an inland sea which stretched from the Gulf of Mexico to 60° N. Lat., or to Alaska. Though there is no elevated divide, there is a watershed between streams flowing into the Missouri and Mississippi and those flowing into Hudson Bay, near and along the international boundary line and the 49th parallel. The natural course for eastward communication and transport from this region to Eastern Canada, the eastern cities of the United States and the Atlantic is by the shortest route to the great lakes, and this route is kept north of Lake of the Woods by the political boundary. The eastward traffic passes necessarily between that lake and Lake Winnipeg, and here at the junction of the Red and Assiniboine Rivers, near where the fertile lands march with the barren Laurentian region, is built the City of Winnipeg. For communication with the southern markets of the United States, the present route is by rail from Winnipeg to Minneapolis and St. Paul on the Mississippi. Four hundred miles of railway connect Winnipeg to Port Arthur and Fort William on Lake Superior. All eastwise traffic must pass those places, but Winnipeg is the actual market of the fertile region and Port Arthur is merely a port of transit and shipment, just as later on Winnipeg will be a place of transit to the great cities which will rise farther north and west.

The soil of large areas of these provinces is a peculiar black clayey earth, called in the United States gumbo, and is believed to be a vegetable formation of lacustrine origin. It is very widely distributed in the eastern parts, but less so as the ground rises in the west towards the foothills of the Rockies. To its extraordinary fertility, and to the climate, is due the enormous capacity of the district for growing grain, and especially wheat. The total rainfall is low, averaging about 17 in., too low at first sight for very large crops, but of these 17 in., 13 in. fall in the growing months, April to September. Not only are the crops large, but the quality produced is extraordinarily high. To quote Mr. George Harcourt: "The great stretch of land lying for 1,000 miles along the international boundary from the Red River to the Rocky Mountains enjoys a climate peculiarly its own. The long days of bright sunshine, together with the abundance of nitrogen in the soil, seem to supply just the right combination necessary to produce a clear hard flinty grain possessing a high percentage of gluten." And Mr. Miller writes: "The marvel increases when one learns that at the present time scores of farms that have been cropped continuously for 28 and 30 years (excepting every third and fourth year for a rest), without the aid of artificial fertilisers, are still very fertile. Some idea of the fertility of the soil may be gained from the fact that with few exceptions the oldest farms must when fallowed be tilled only sparingly, lest the next crop grown thereon should fail of too rank growth."

The present output of grain by the three provinces is 240 million bushels (over 6 million tons), a quantity double of the output three or four years ago. But the land so far taken up is only 11¼ million acres, just 5 per cent. of that part of the area of the provinces which is known to be suitable for growing wheat. But those whose business it is to follow these matters are convinced that the area can be extended greatly beyond that, especially to the north. Wheat has been ripened successfully in 62° N. latitude, far north of the area mentioned above, a result due to the Chinooks or warm western winds, blowing off the Pacific and across the Rocky Mountains, which are lower in those latitudes than further south. The isothermals take a strong bend northwards in that region. Wheat grown at the Peace River in N. latitude 56° (Edinburgh) took first prize in the Chicago Exhibition in 1893, and that grown at Chipewyan in N. latitude 59° (Orkney Islands) took first prize at Philadelphia in 1876. In 1908, 6,000 bushels of wheat raised on a farm in 58½° N. latitude sold at $1·25 the bushel. It is said on the authority of Prof. Macoun, of Ottawa, that wheat can be ripened as far north as 66° N. latitude. Improved agriculture and new kinds of quickly ripening wheat will still further increase the production. It would seem that in the near future the annual yield of these provinces and the territory north of them will much exceed 5,000 million bushels of grain. Much was said in the papers read before the Section at Winnipeg of the organisation for handling the grain, the regulation of the elevators, and the maintenance of standard grades. The machinery for this is organised, works well, and can be extended as required.

But how is this output to be transported away from the country?

Ultimately much of it will go westwards over the Rocky Mountains to the Pacific ports; and when the United States become buyers of wheat instead of sellers, Canadian wheat will go south to the Missouri and the Mississippi. But it seems as if most of it must, in any case, go eastwards, and the bulk is so great that it must travel by water as much as possible, so that provision for water transport to and from these provinces is an urgent question for the Canadian Government.



MAP SHOWING THE INDUSTRIAL FEATURES OF CANADA. Copyright.

We have now to deal with the lake route between Montreal and Lake Superior. There is no passage for ships on the St. Lawrence above Montreal, owing to the rapids, but ships not exceeding 270 ft. in length, 45 ft. in. width, and 14 ft. draught, can pass from Montreal to Lake Ontario by a series of canals on the Canadian side having 21 locks and rising 206 ft. From Ontario into Erie ships of the same dimensions can pass by the Welland Canal parallel to the Niagara River on the Canadian side. Lakes Erie and Huron with the Georgian Bay are on the same level, and the Detroit River between Erie and Huron will carry ships drawing 20 ft. of water. At the Soo between Huron and Superior, locks on both the Canadian and American sides will take ships 600 ft. long, 60 ft. wide, and

The present position is as follows: All grain going eastwards passes by rail *via* Winnipeg to Fort William or Port Arthur on Lake Superior: that is to say, the nearest point for water carriage is 400 miles by rail from the nearest point of the grain-growing provinces. So far, no scheme is proposed for reducing that, and the ports on Lake Superior are the head of navigation at present in view. For Atlantic ports, the grain is shipped from Montreal. The St. Lawrence now carries ships drawing 27½ ft. of water up to Montreal at all states of the tide, and the dredging necessary for a depth of 30 ft. is nearly completed, and that depth will be available next summer. Then the work of increasing the depth to 35 ft. will be begun, which when completed will make the port available for all ships, excepting a very few.

drawing 20 ft. of water. Thus the present navigation provides for ships drawing 20 ft. between Lake Superior and the American ports of Duluth, Chicago, Milwaukee, Detroit and Cleveland, but only much smaller ships, drawing less than 14 ft., can reach Montreal. Either then the grain travels all the way by rail on the C.P.R. to Montreal, there to be delivered through the elevators to the holds of ocean-going steamers, or it travels the whole or part of the way by small boats and undergoes several transhipments.

Clearly the development of the wheat country will be choked unless better means of communication can be provided.

Two schemes are proposed. One is to enlarge the canals and locks between Montreal and Kingston on Lake Ontario, and also the Welland canal between Ontario and Erie to take vessels of the same size as those which can now pass the Soo. The other is to construct a new channel between Montreal and the Georgian Bay by way of the Ottawa River, Lake Nipissing, and the French and Pickerel rivers, this also to take vessels of the same size as can now pass the Soo locks. The distance from Montreal to Georgian Bay would be 440 miles, the rise to the summit level of Lake Nipissing from Montreal would be 659 ft. in 23 locks, and the descent to Georgian Bay 98 ft. in 4 locks. Of the 440 miles, 346 would pass through rivers and lakes, 28 miles would be excavated, and 66 miles would be dredged. The time of passage is estimated at 70 hours for a lake steamer of 12 knots, and the route would be open for seven months of the year.

The latter scheme is likely to be adopted, on the ground that the former plan gives a route liable to be interrupted in the event of political difficulties with the United States. The cost is put at 100 million dollars, and as a set-off against this it is estimated that water powers of a one million horse-power will become available, and could be brought into use at a cost of $50 per horse-power. In addition a large new tract of land will be opened up for settlement. In point of time saved there is not much difference between the two routes, but the Ottawa is a magnificent river, and the new waterway will be a noble addition to the resources of the Dominion when it becomes a regular route for large vessels. The effect of the construction will be that ocean-going steamers of 7,000 tons of the ordinary tramp type will be able to load grain to nearly their full capacity on Lake Superior and complete their cargoes at Montreal for any Atlantic port; while foreign cargo and coal will be carried to the very heart of the Continent in ocean steamers without trans-shipping.

The opening of the Georgian Bay Canal may have another important effect on the Dominion trade. An enormous traffic, 40 million tons per annum, now passes the Sault Ste Marie locks by lake boats carrying iron and copper ore from Lake Superior to Cleveland on Lake Erie for Pittsburg. These boats are of a very peculiar type. They resemble very long barges, being undecked, except at the stern where they have engines and boilers, and at the bows where the crew live in a kind of elevated castle. They are as much as 600 ft. long, and carry loads of 10,000 or 12,000 tons. They are well adapted to lake traffic, but are probably not suited for ocean traffic. Their dimensions, however, have fixed those of the Georgian Bay Canal locks. There is no coal in central Canada (excepting beds of lignite in Manitoba and Saskatchewan), and these lake boats, which are run primarily to carry ore to Pittsburg, bring return cargoes of Pittsburg coal to Lake Superior, and it is from this source that all that part of the continent and the lake steamers get their supplies. The opening of a deep water route from the St. Lawrence may enable Cape Breton to send coal to Lake Superior as return cargo for the grain ships. This will remove the disadvantage under which the Canadian lake boats at present suffer, viz., that they have no return cargo for the westward voyage, while the American boats carry coal from Cleveland. Similarly in the West, the British Columbia, and Rocky Mountain mines can supply Alberta and Saskatchewan.

Besides the Georgian Bay Canal another route to the Atlantic is contemplated—that by Hudson's Bay, and a branch line 550 miles in length has been surveyed connecting the nearest point in the grain district on the Canadian Northern Railway to the mouth of the Churchill River on Hudson's Bay. The value of this route will depend no doubt upon the average time during which it would be closed by ice in Hudson's Strait or by shore ice at the port. There is, moreover, more than one continuous waterway between Lake Winnipeg and Hudson's Bay, and the Saskatchewan River runs from the Foot Hills of the Rockies into Winnipeg. Canadians look to some of these routes being made navigable in the future, so that grain can be shipped from the heart of any of the provinces.

For the development of the provinces, water transport is necessary for the heavy grain cargoes; but, as in the past so in the future, the railways must open up new lands, carry on communications, and collect and distribute the trade of the ports. Western Canada has grown up with the C.P. Railway, and Lord Strathcona is king in Winnipeg. But Canadians intend that the development of the country shall not be hindered by the establishment of commercial monopolies, and partly with the idea of opening competition with the C.P. Railway, partly from Liberal party motives of having something to set off against the great work of the Conservative party in building that line, but largely no doubt from the sheer necessity of providing more railway facilities, a new line is under construction from Monckton at the head of the Bay of Fundy to a new port, Prince Rupert, on the Pacific. The route runs more or less parallel to the C.P. Railway, crossing the St. Lawrence above Quebec, where the great cantilever bridge has failed under construction, passes through Winnipeg, and connects with Port Arthur, but except at Quebec running wide of the St. Lawrence and Ontario ports through new country. From Monckton to Winnipeg, about 1,900 miles, the line is being constructed by the Dominion Government, and is called the National Trans-Continental Railway; and beyond Winnipeg to the coast by the Grand Trunk Pacific Railway Co. Both the C.P.R. and this new line look to competing with the water routes for the carriage of grain, and at certain rates will no doubt obtain their share of the traffic. The essential condition for economical working of the heavy train loads is that the gradients shall be easy. The Trans-Continental Railway—we take our figures from Mr. Duncan MacPherson's paper—look to drawing single train loads of 4,290 tons gross, 2,860 tons net (nearly 100,000 bushels of wheat) behind one engine (Mallet articulated compound) by keeping the gradients to a maximum of ·4 per cent., compensated for curves; and they have maintained this throughout the whole distance except in two places of 12½ and 10 miles in length respectively, where gradients of 1·1 per cent., adverse to east-bound traffic, are permitted in view of the very large economies in construction obtained thereby. They reckon on carrying wheat profitably from Winnipeg to Quebec, 1,351 miles, for 4·25 cents per bushel, 1s. 5d. per quarter, or, say, 17 ton-miles for 1d.

Similarly an elaborate paper by Mr. T. E. Schwitzer contained an account of two great works on the C.P.R., near the Rockies. One is the Lethbridge Viaduct, more than a mile long and over 300 ft. high, and the other the grade revision in the Kicking Horse Pass. The viaduct is a piece of economical reconstruction, which will pay immediately for itself, but the grade revision is a costly piece of work, involving two long spiral tunnels, and is only justified by the prospect of economy in hauling the heavy traffic anticipated in the future. The present 4·5 per cent. grade over 3·7 miles is reduced to a 2·2 per cent. grade over 7·5 miles, which allows two engines to draw 980 tons, where four engines are now required to draw 700 tons.

The papers on Canadian problems, of which we have attempted to give a general account, were the following:—

Sir W. H. White, K.C.B.—Presidential Address.

Lt.-Col. W. P. Anderson, M.Inst.C.E., Chief Engineer of the Department of Marine and Fisheries.—"Improvements in the Navigation of the St. Lawrence."

Report of the Commission on the Georgian Bay Canal Scheme—Abstract prepared for the Section.

Major G. Stephens.—"The St. Lawrence River, the Great Imperial Highway."

T. E. Schwitzer, Assistant Chief Engineer, C.P. Railway.—"Recent Engineering Works on the Canadian Pacific Railway."

Duncan MacPherson, M.Inst.C.E.—"The National Trans-Continental Railway."

George Harcourt, Deputy Minister of Agriculture, Province of Alberta.—"The Development of the Grain Industry of Western Canada and its Future Possibilities."

W. H. Lanigan, Assistant Freight Traffic Manager, C.P. Railway.—"The Transportation of Grain."

John Miller, Experimental Farm, Indian Head, Saskatchewan.—"The Development of the Grain Industry in the West, and Grain Storage."

W. A. P.

The Municipal Hydro-Electric Works of the City of Winnipeg.*

The present Public Utilities Co. which is operating in and around the City of Winnipeg, has a monopoly of such a nature that the municipal authorities have decided not to await the expiration of the present franchises, which would enable the city to assume control either of these present properties, or to arrange new agreements for further control of rates. The only other course logically open was to create competition, for the reason that the cost of fuel in Winnipeg is excessive and does not offer effective means of competition in itself by the private production of electric energy. This competition might have been created by chartering a second company for the production and sale of hydro-electric energy, but the history of such efforts has usually been that of amalgamation, and a repetition of monopoly. Whether or not such or any monopoly is, or is not, when regulated, for the best interests of a city, need not be discussed here, but the decision was reached in 1905 to construct municipal works, for the purpose of creating the competitive condition desired.

In that year a careful examination was made of the hydraulic resources of the Winnipeg River, which has its chief gathering grounds in the lake country of Western Ontario, and which flows through the eastern portions of the Province of Manitoba and empties into Lake Winnipeg, after passing through a rock-ribbed country very suitable for such works as were contemplated. The report presented justified the city authorities in making contour surveys of the most promising power sites, which were performed during the following winter, after which followed engineers' estimates of cost in April, 1906, and a popular vote of $3,250,000 in June, 1906, which indicated clearly the then desire of the property owners of the city, which was to expend the above-mentioned sum on municipal hydro-electric works.

In October, 1906, the designs for works were begun, and it was then contemplated to complete the same in 2½ years; the financial stringency of 1907 caused a set back of over a year, but the construction is now being vigorously prosecuted, over $500,000 has been expended, and further contracts of over $1,000,000 are now in process of completion, whilst further contracts for equipment and distribution are soon to be placed, and it is contemplated to have the works in operation ready for delivering power within the next 18 months.

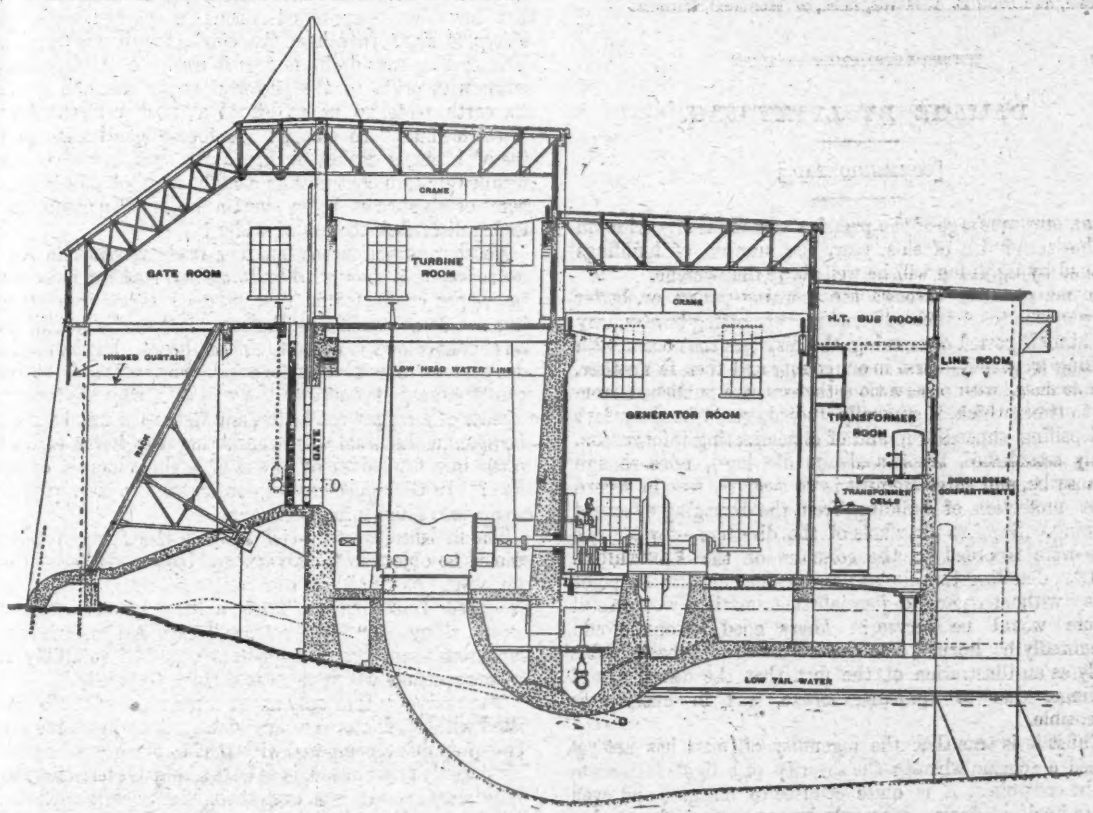
The undertaking will consist, when completed, of the following:—

A 60,000-h.p. generating station, operating under 45 ft. to 46 ft. o hydraulic head; a 77-mile transmission, consisting of four three-phase circuits carried on two series of double-circuit steel towers with concrete footings; a terminal station in the city, at which the pressure of the current transmitted will be reduced to 11,000 volts. An underground cable distribution to three or more sub-stations, where the pressure will be reduced to 2,200 volts and or 550 volts; and a secondary underground and overground distribution to customers. The distribution has not yet been studied in detail.

At Point du Bois there is a large lake adjacent to the head gates, a contour favourable to economical works, rock foundations for all constructions, and a difference of hydraulic level which will be practically constant. The water is free of silt and other objectionable matter.

After studying various possible designs, it was decided to build concrete overflow walls, a rock-filled dam, and a power house with wheel pits built as an integral part of the head block, and a transformer station, also integral with the power house itself. Further consideration of cost and climate gave as a result an enclosed forebay room, and double runner turbine units of 5,200 h.p. capacity each, at a speed of 164 r.p.m., also motor-operated head gates protected by stop log arrangements; the whole power house is again protected by head-gate piers in the canal, by which the canal can be unwatered by the use of stop logs.

The generating room will ultimately contain two turbine-driven exciters of 250 kw. each, two motor-driven exciters of the same capacity, and 16 main generator units of 3,000 k.v.a. each, operating at 6,600 volts, 60 cycles, three-phase; of the above, five main units and two exciters are to be now installed. These generating units will be so arranged as to be operative in groups of three per bank in accordance with a similar grouping of the step-up transformers. Electric travelling cranes of suitable capacity will be installed in the generator and turbine rooms.



Sectional View of the New Winnipeg Municipal Hydro-Electric Works.

The generating station will be built throughout of reinforced concrete upon plain concrete tailrace walls. A cross-section of the building is shown upon which will be observed the natural arrangement of the equipment and the resulting simplicity of the station design.

The transmission system will be constructed upon a 100-ft. private right-of-way, and by the shortest feasible route. The towers are built up of structural shapes in an economical design and are of two types—braced (in which the spread of the base is about one-fourth the height of the tower) and flexible, consisting of channel irons supported in a plane normal to the axis of the wires; both types will be supported upon rigid concrete footings. Each line of towers will support two three-phase circuits of aluminium cable mounted upon pin type insulators.

A single-circuit telephone line will parallel the transmission line upon cedar poles.

The terminal station in Winnipeg will receive power at 60,000 volts, and will deliver it to sub-stations at 11,000 volts, by means of a three-conductor underground cable system.

* Abstract of brochure issued at the B.A. meeting at Winnipeg.

The transformers will be of the water-cooled type in both generating and terminal stations, but of the water circulating class in the former, and of the oil circulating type in the latter station.

The high-tension bus-bar system in both stations will be of the open type. In both stations a very complete system of switching will afford the maximum of flexibility.

Twenty-five miles of standard-gauge railway were constructed from Lac du Bonnet to the power station site. A small equipment, the property of the city, is now in operation thereupon.

Upon the completion of the plant, there will be an immediate market for a considerable block of the generated power, as the city is widely spread and is rapidly growing. Its street lighting and public building services will be supplied, and it will use its own electric power for pumping its water supply. This supply is obtained from a series of artesian wells, each already equipped with electrically-driven pumps. The problems of sewage disposal will also require the use of a pumping system before many years.

In addition to the municipal and other public services, there is a rapidly growing demand for electric power for manufacturing, and to this market the city supply will be offered at attractive prices. Even now there are in operation in Winnipeg steam plants whose aggregate demand approximates 15,000 H.P.; and the development of the vast country to the west of the city, combined with the very high freight rates from the east to Winnipeg, and the consequent cost of fuel, all tend to force a rapid increase in the application of electricity here.

The authorities placed the design and construction in the hands of Mr. Cecil B. Smith, Ma.E., of Toronto, Ontario, now of the engineering firm of Smith, Kerry & Chace. The City Council also retained as a board of consulting engineers Messrs. Col. H. N. Ruttan, C.E., of Winnipeg; William Kennedy, junr., C.E., of Montreal, and Prof. L. A. Herdt, E.E., of Montreal, Canada.

DAMAGE BY LIGHTNING.

[COMMUNICATED.]

If the storm wreckage of the past few months is any criterion for the remainder of this year, the number of buildings damaged by lightning will be well above the average.

Anyone glancing through the morning papers, or, better still, who is in touch with some newspaper-cutting bureau, may keep himself posted concerning the disasters that occur with unfailing frequency—first in one county and then in another. Reliable data, with observations thereon, are published from time to time, which, if generally studied, would be the means of dispelling superstition and of disseminating information. Firmly established theories always die hard, false though they may be, and this statement is particularly true in regard to the protection of buildings from the damaging effects of lightning. Suppose the whole of the disasters—say for one year—were recorded in the columns of the Electrical Review, detailing the circumstances from a scientific point of view without regard to journalistic trimming, what useful purpose would be served? Many good lessons would undoubtedly be learned, but the record would be valuable chiefly as an illustration of the fact that the demolition of buildings, due to lightning stroke, was in every case preventible.

Whilst it is true that the ingenuity of man has not yet devised a scheme whereby the severity of a lightning storm can be controlled, it is quite possible to mitigate and even nullify its dire effects. The only known means of ensuring safety to property is the system propounded by Dr. Benjamin Franklin more than 150 years ago, namely, the placing of metal rods a foot or so above the loftiest pinnacles, continuing the lines of conduction into moist ground, and there extending them as circumstances may dictate, so as to obtain a low resistance.

There is a limited sense in which the severity of a lightning storm can be minimised, this being possible when buildings are liberally supplied with pointed conductors in the vicinity of a storm cloud. These tend to prevent a disruptive discharge when the sky is overcast and the elements become charged with electricity. Hence the more lightning rods there are below a thunder cloud, the less severe will be the storm. Some writers have gone to the extent of asserting that a perfect conductor ought never to be struck. This is, of course, untenable, but it may safely be maintained that every lightning conductor in the storm zone is making a persevering effort to effect equilibration before the tension has attained a dangerous magnitude.

In this respect the function of a lightning rod may be likened to that of a safety valve which enables the steam to escape from the boiler before it has risen to an explosive pressure.

Present day knowledge of the laws governing the phenomena of lightning, though yet meagre enough, is far in advance of the knowledge possessed by the famous Philadelphian printer; indeed, it is no exaggeration to say that much light has been thrown upon the subject during the past 10 years. Whether that knowledge is sufficiently diffused to bring about a diminution in the number of buildings damaged by lightning is another question. It may be taken for granted, however, that whenever a lightning conductor system has failed, a competent authority could have predicted the result as easily as a journalist could have described the accident afterwards. Some glaring defects must have existed, either in its initial application or through subsequent deterioration, that would fully account for the accident.

Is it not a fact that plumbers, building contractors, and steeple jacks, secure a large number of contracts for the protection of buildings, while the man who proposes to install a conductor system based upon a long experience, and who would apply that system in a scientific manner, is ruled out of consideration because his estimate does not happen to be the lowest? Sometimes one comes across limestone chippings that have been sprinkled about a copper earth plate *to keep it dry!* In others the conductor rope is terminated in an earthenware drain *to keep it wet!* A third contractor points with pride to the perforations he has had made in the earth plate, so as to afford a readier means for the "electric fluid" to escape! A fourth gentleman in this line of business makes it his boast that every conductor installed by him continues in a high state of efficiency, the secret of his success being due in no small measure to his having discarded the use of solder!

Another person in the building trade responsible for the protection of a six-storied building had read somewhere that "a copper conductor is not so good as an iron one; it does not damp out the oscillations; it lets the current down too suddenly, and is liable to side flashes." Hence a brilliant idea passed through his fertile mind. Seeing that there was an iron fire escape fastened to the wall side, why not forego the expense of a copper conductor, and fasten the finial rod above the apex in the usual way, connecting the lower end of it to the iron fire ladder by means of a short length of metal tape? In this ingenious fashion he tried to convert the fire escape into a lightning conductor.

The multitudinous dry joints down the zigzag iron ladder seemed no objection to this enterprising contractor, and when the work was finished the resistance, which was variable, measured 1,600 ohms. Truly a little learning is a dangerous thing. "False science," says Arago, "is no less dangerous than complete ignorance, and it infallibly leads to consequences which there is nothing to justify."

The marvel is that only about 2 per cent. of the buildings fitted with conductors are ever damaged by lightning stroke. This proportion, compared with that in the case of structures left entirely unprotected, is at least a valuable testimony to the usefulness of conductors, even though improperly applied. Yet it is beyond dispute that the practice of guarding against the effects of lightning is not so general as was the case some years ago. The question naturally arises, what is the reason that so many people owning valuable property seem disinclined to avail themselves of the recognised protective devices? Perhaps the two following instances, culled from the daily papers, may afford a clue to the mystery, and since both mishaps are typical of others that could be cited, a perusal of the same should give rise to reflection and speculation:—

1. During a heavy thunderstorm the parish church . . . was seriously damaged by lightning, the weather-vane and a portion of the spire being demolished. Masses of masonry fell through the roof of the church, which was wrecked, and considerable damage was done to the belfry. It is feared that the steeple will have to be rebuilt, as there is a bad crack extending towards the base. The church was recently restored, but owing to lack of funds, a lightning conductor was not then fixed.

2. One flash of lightning more vivid than the rest, quickly followed by a heavy peal of thunder, caused a

gentleman at . . . to exclaim : "That's hit something!" A minute later, the telephone bell rang, and the gentleman referred to was informed that his works chimney, 120 ft. high, had been almost shattered by lightning. On going to the workshops a scene of wreckage presented itself. Broken brick work was strewn up and down, some of which had been hurled a distance of 50 yards, causing much damage to neighbouring property. So bad is the rent from the chimney cap downwards that the chimney will have to be razed. A lightning conductor had not been provided.

One cannot but express regret at reading of a church being damaged by lightning, especially when owing to economical considerations a lightning conductor had not previously been installed. Churches and chapels not being dividend-making concerns are often burdened with debt; and even if free from pecuniary embarrassment, the ecclesiastical authorities are usually busy in the promotion of schemes that will involve them in debt. Nevertheless, it is a false economy to disregard the possible effects of lightning as many church officials know to their regret. If the provision of lightning conductors to buildings were postponed because of the initial cost, or on account of indifference, such a state of affairs would indicate the need for pioneer work on the part of those qualified electrical engineers who make a speciality of the business. In soliciting orders, it should not be difficult to prove that in rendering their clients secure they are conferring a benefit on them commensurate with the benefit derived from them.

It is surprising how many people neglect the provision of lightning conductors because the importance of the subject has never been brought before their notice. To appeal to the instinct of fear is neither desirable nor necessary, as such an appeal would merely exert a disturbing influence of a temporary character upon the mind. A scientific presentation of the situation will, in many cases, induce the clergy, property owners, &c., to realise the danger they are running, and to inquire how that danger may be averted.

Reference has been made to indifference as a reason why people do not instal conductors to a greater extent than could be desired. Indifference is due to a variety of causes. In its crudest form it arises through ignorance; but this cannot surely be the general reason why so much apathy prevails respecting the subject under consideration. A state of indifference is sometimes the result of an intelligent inquiry. After reading the conflicting opinions of those who "know," an impression is formed upon the mind of the inquirer that the subject is remote from anything that matters.

How many authors have been responsible for leading their non-technical friends to assume an attitude of indifference concerning the value of lightning conductors, it would, of course, be impossible to say. Some writers have a style so lucid that the reader is carried away with rhetorical music.

As an instance, it has often been asserted that "if a conductor is faulty it constitutes a menace to property." In order to present the cases fairly, a few *bonâ fide* extracts are appended. The number could be multiplied without difficulty did time and space permit.

"(*a*) It is better for any building, factories in particular, to be without any lightning conductor at all than to be fitted with such as are defective or badly planned."

"(*b*) In judging the danger from lightning, the following local conditions should be taken into consideration :—The danger is heightened by the presence of old and useless conductors."

"(*c*) It may be taken for granted that a building, if fitted with an imperfect conductor, is in a more unsafe condition than if none existed."

"(*d*) It has been conclusively proved that lightning conductors are worthless as a safeguard against lightning."

Some of these sentences sound like decrees; there is an authoritative mannerism about them which is apt to dominate the uncritical mind. In determining their collective value an elementary test should be applied, namely, the test of accuracy. In this connection it is a curious feature that those who regard a building with a faulty lightning conductor as being in a more unsafe condition than it would be without one, do not attempt to justify their statements. Personal investigation into the circumstances "of damage by lightning" leads to a conclusion the opposite of those before mentioned. Consider the following case :—A lightning flash struck the vane of a country church, the spire of which had been fitted with a conductor 30 years previously. Owing to long neglect, or perhaps to theft, the conductor was severed above the porch; below that point it was missing. Apparently the flash had struck the vane, traversed the metal rope until it was "side-tracked" above the doorway, whence it ran along an iron rain-gutter, tearing the latter from its fastenings. Then it followed the metal down spout and afterwards crashed through the wall with explosive force, igniting a composition gas pipe on the other side, eventually causing—as a secondary effect—a fire among some furniture.

To argue from the particulars furnished that the church would have been safer without a conductor would be contrary to sound reasoning. Notwithstanding the palpable defect already referred to, the *presence of the conductor from the vane downward saved the church spire from destruction*, and if only the lower part had been metallically continuous to the earth, it may be safely surmised that no harm would have befallen the edifice.

In the month of May, 1751, a pamphlet was published in London, entitled "New Experiments and Observations on Electricity," made in Philadelphia, in America, by "Benjamin Franklin." One of the incidents recorded in that old-time essay is quite relevant to the question at issue, and should, therefore, be of special interest :—

"The second conductor which Franklin constructed was placed upon the house of Mr. West, a wealthy merchant of Philadelphia. A few months after this had been erected, a storm burst over the town, and a flash of lightning was seen to strike the point of the conductor and to spread itself out as a sheet of flame at its base. It was afterwards found that about 2½ in. of the brass point had been dissipated into the air and that immediately beneath, the metal was melted into the form of an irregular blunt cap. The house, nevertheless, was quite uninjured.

The sheet of flame seen at the base of the conductor, Franklin correctly ascribed to the ground having been very dry, and to there not having been a sufficiently capacious earth contact under the circumstances. He nevertheless shrewdly and quite justifiably assumed that in this case nature had itself pronounced an unmistakable verdict in favour of his invention.

Speaking generally, thunderstorms are much more severe in the United States than in this country. Yet the principle involved is the same here as elsewhere. Lightning is not erratic; it is governed by law. A flash will take the path of low resistance in preference to a high one, whence it follows that a building is far safer with a metal conductor fixed thereto—even though it may be defective in certain particulars—than if no conductor existed.

In an interesting letter to the Electrical Review, dated August 31st, 1907, Mr. Alfred Hands, F.R.M.S., very properly maintained that a lightning conductor might be in such a bad state that the upper and lower parts were missing; but to assert that it was worse than none at all would be to argue that partial damage would be necessarily greater than complete wreckage of the building from top to bottom. He regarded almost any conductor as better than none, though it might be so bad as to be almost useless.

Seeing that there is no foundation for the erroneous theory so often propounded that a defective conductor is a menace to property, it is extremely unfortunate that technical writers are occasionally found stating as true what science and experience has shown to be false. Hence there need be no surprise at the indifference of the general public. The latter, being unacquainted with the technique of the business, will incline to the view that if their buildings are only safe while the conductors are perfect, the time may come when they will get out of order, and the last end will be worse than the first.

Let it not be assumed that we are under-rating the importance of a properly-planned conductor system. Unless this is seen to in the first case, there is a risk involved—and a risk that need not be incurred if the precaution is taken of having (1) an installation fitted by a recognised expert, and (2) by insisting upon a periodical inspection and test afterwards.

The value of a periodical inspection is, perhaps, scarcely

appreciated. Rain spouts are cleaned and painted at regular intervals, but a lightning conductor is expected to continue in a perfect condition without attention through an indefinite period. To be more precise, the existence of the lightning conductor is entirely overlooked when once it is installed.

A conductor system may have been fitted in a perfect manner; it may have been tested regularly twice per year, and the resistance, compared with previous readings, found unaltered, and yet in the meantime some alteration to gas or water supply pipes—inside or outside the structure—may have been made which has rendered the system inefficient, notwithstanding the satisfactory tests. These faults can only be discovered by a periodical inspection, and a careful consideration of the problem in its altered phase. That this is no fanciful theory unsubstantiated by fact, could be easily shown. Petroleum barrels are sometimes stacked in a corner where the conductor is cleated to the wall, the iron hoops encircling the barrels being inadvertently left within sparking distance of the lightning conductor; in others, gas pipes have been fastened to the chimney brickwork for support, and left in metallic contact with the conductor. Mistakes of this kind are generally caused by yard labourers or by gasfitters, who are unfamiliar with the precautions that ought to be taken. Men in humble positions, however, are not alone in arriving at wrong conclusions, as may be gathered from what is hereafter stated.

A number of gentlemen interested in the science of lightning once formed the opinion that Sir Oliver Lodge, F.R.S., had identified himself with those who regarded a faulty conductor as being worse than useless. A meaning had evidently been given to his words, different from that which he intended them to express; but that distinguished scientist issued a disclaimer in language the most emphatic.

REVIEWS.

The Design and Construction of Induction Coils. By A. F. Collins. New York: Munn & Co. Price $3 net.

Coming at the end of a fairly long sequence of books on the induction coil which have been published from time to time, this latest addition by an American author is far and away the most practical and useful treatise on the subject that we have seen. With the advent and rapid development of radiography, and, later, wireless telegraphy, the old rule-of-thumb system as applied to coil construction in this country has given place to exact methods of design and construction, in which the underlying principles of the induction coil as a means for producing currents of high potential have been carefully studied and properly applied.

In this matter of coil construction the American system differs materially from that in favour in this country, American coils being of less expensive design and construction, whilst at the same time equally as efficient as the higher class productions of our leading manufacturers.

The book under notice takes the form of a carefully-detailed specification for the construction of eight different sizes of coils, of capacities ranging from a ½-in. to a 12-in. spark length. These are covered by three separate and distinct designs, according to the size of the coil, and every conceivable detail is included and its dimensions recorded for the guidance of both amateur and professional coil builder.

The first two chapters, dealing with historical and theoretical considerations, are commendably brief, having regard to the fact that most prospective makers of such coils are already familiar with the elementary principles of the subject. Chapter III discusses preliminaries, and includes some useful hints and advice bearing on the ultimate purpose for which the finished coil is intended. The author's plaint on p. 25, concerning the present unsatisfactory method of rating induction coils according to spark length is well founded, and at the present stage of the coil-making industry it might well be amended. Instructive features of this chapter are the curves illustrating the effect of varying the quantity of iron in the core, and the capacity around the break respectively.

From this point, commencing with Chapter IV, the general scheme of the book, which has been most efficiently carried out, consists in devoting a chapter to each stage in the process of coil building, as, *e.g.*, "Forming the Soft Iron Core," "Winding the Primary," "Insulation between Coils," "Winding the Secondary," &c. Each of these chapters includes a table or tables, giving the exact dimensions, weight, or any other data necessary, of each and every detail for the whole series of eight coils; from this it will be gathered that very little is left to the imagination, and, in point of fact, the most unskilled amateur should experience little difficulty in building a very serviceable and efficient coil with the aid of this book.

On p. 73 is described a method of plotting the maximum field of force as a guide in graduating the secondary winding. Although by no means original, we do not recall having come across it before in a text-book on the subject of coils; the author has, however, ignored the trembler which, when in action, has the effect of distorting the field to some extent at one end of the coil.

In the treatment of coils after winding, we are pleased to note the inclusion of a chapter on vacuum drying and impregnating apparatus; it is, however, somewhat brief, and conveys only a rough idea of this now almost universal system of treating coils. In the section on interrupters, we are rather surprised to find no reference to the higher frequency mercury and electrolytic breaks, the subject being dismissed in a subsequent chapter with a few words relative to their heavy current consumption. Only three of the simplest spring interrupters are described in Chapter X, as most applicable to the whole series of eight coils. The subject might have been enlarged upon with advantage.

As regards the condenser, we commend the sub-divided principle of construction, as recommended for the larger coils. This section is particularly well written, and should be of great assistance to the coil builder in helping him over what often proves the most troublesome detail of the whole equipment. The final chapters on wiring diagrams and sketch plans for assembling the coils are also particularly clear.

Chapter XIX, on the cost and purchase of materials, is an ultra-refinement, which, whilst rendering the book complete in every detail, is calculated soon to become obsolete, owing to fluctuations in the market. Of far greater value is the final Chapter XX, comprising over 30 pages of most useful tables and formulæ bearing on every branch of induction coil design and construction.

We have nothing but praise for the publishers' share in the production of this book; the printing and illustrations are commendably clear, and afford evidence of careful revision, whilst the various tables of contents are particularly thorough as aids to ready reference.

The Gas, Petrol, and Oil Engine. Vol. I. New and Revised Edition. Thermodynamics of the Gas, Petrol, and Oil Engine. By Dugald Clerk, F.R.S., M.Inst.C.E. London: Longmans, Green & Co. 1909. Price 12s. 6d. net.

The first edition of this work appeared in 1886, under the title of "The Gas Engine," and later, with considerable additions, in 1896, as "The Gas and Oil Engine," but owing to the rapid development of the science and practice of the internal combustion engine, the present edition has practically been re-written and divided into two volumes. The first 50 pages of Vol. I give an historical sketch of the gas, petrol, and oil engine up to 1908 in a condensed and practical manner, which will be found interesting and useful to internal combustion engine students and designers.

The modern large-power gas engine is shown to have resulted from the successful working of gas of low heating power, combined with increase in compression pressures.

A notable advance in gas engine proportions was the Cockerill engine of 1899, a single cylinder of 51·2 in. diameter, developing 600 h.p. with blast-furnace gas, and since then the scope of this system of power development has rapidly advanced in directions quite outside those previously commanded by gas and oil engines. The rest of

the volume is chiefly devoted to the thermodynamics of the internal combustion engine, including the principal experiments upon the causes of loss in gas engine cylinders; combustion and explosion under various conditions, and with different mixtures of combustibles with air; and the cooling of the products of explosion in closed vessels, and behind a moving piston. Mathematics are only introduced to a minimum extent necessary to apply the laws involved, and this enhances the value of the work as a ready reference book, for while all the most recent experiments are recorded, the results arrived at can be consulted without having to wade through a mass of figures. Appendices include much valuable information, including the Report of the British Association Committee on Gaseous Explosions, Dublin, 1908.

Seeing that the time occupied by a single complete stroke of the piston in small cylinders ranges down to less than 0·02 second, and that the maximum pressure due to the explosion may be about one-fifth of the stroke, this allows 0·004 second in which complete (?) combustion has to be effected, and on page 113 we find that the velocity of flame propagation for hydrogen (2 vols. H + 1 vol. O) is 34 metres per second, which is equivalent to 5·46 in. in 0·004 sec.; however, this rate is much increased at constant volume (page 116), and the least time to reach maximum pressure of any combustible experimented with was 0·01 second, while petrol and air in a closed vessel occupied 0·058 second, from which it would appear that the conditions obtaining in gas engine cylinders are not in line with those under which the experiments reported were made, or that only partial combustion results from high speeds of revolution.

While a study of the volume shows that there is still much to be found out in relation to the thermodynamics of the internal combustion engine, it also, in an admirable manner, shows what valuable work is being done in this direction.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New Cable Suspender.

A new suspender for heavy cables has just been brought out by Messrs. W. T. Glover & Co., Ltd., of Trafford Park, Manchester,

Fig. 1.—Glover's Cable Suspender.

in which the eyelet principle has been abandoned in favour of the wedge, as shown in fig. 1.

The sling is of sheet lead braided with compounded yarn, and shaped to give a wide bearing for the cable; the hook and collar are of galvanised steel, carefully designed so that the ends of the sling are not bent where they enter the collar, and the strain is uniformly distributed over the whole sectional area of the ends of the sling. The hooks slide readily along the span wire, but the slings do not slip along the cable, so that there is no fear of their getting out of position when erecting the latter; neither will the slings come adrift from the hooks. The design is evidently mechanically sound, and the suspender appears admirably adapted to its purpose.

Jandus Regenerative Arc Lamp.

A new and improved pattern of their "regenerative" flame arc lamp has been brought out by the Jandus Arc Lamp and Electric Co., Ltd., of Hartham Road, Holloway, N. As explained in our

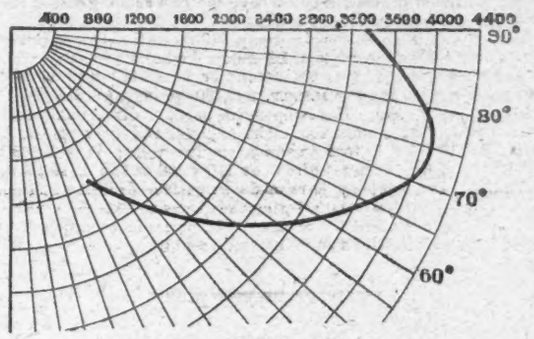


Fig. 2.—Illumination Curve.

first notice of this lamp (March 6th, 1908, page 415), it is of the enclosed type—the only enclosed flame arc made, we believe—and the globe is provided with side tubes for the purpose of circulating

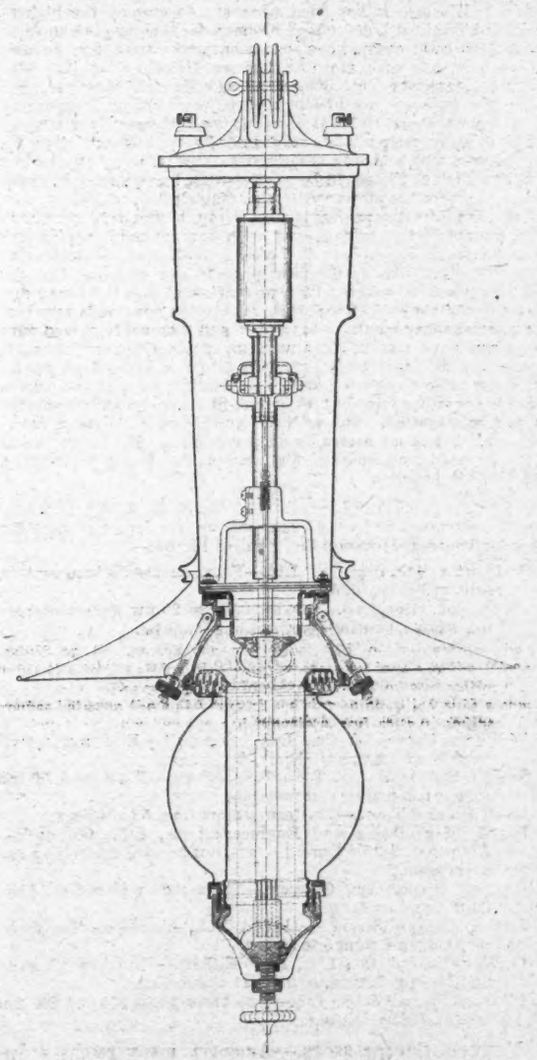


Fig. 3.—Section of Jandus Flame Arc Lamp.

the fumes and gases generated, with the view of preventing their deposit on the mechanism or globe, and of subjecting them repeatedly to the action of the arc in order to increase the life of the carbons. The positive, or lower, carbon, is of star section, the grooves between the eight rays of the star being filled with a composition of calcium fluoride and tungstate, and salts of sodium and

potassium. The negative is a high-grade carbon sliding vertically in the central tube of the lamp. Special advantages are claimed for the use of vertical carbons on the score of simplicity and reliability, and the accompanying sectional view, fig. 3, shows that the mechanism of the new pattern is extremely simple; it is provided with patented ball bearings, giving extremely sensitive control and steadiness of burning. Only 15 grains of the chemical composition are volatilised per hour, and the lamp burns for 70 hours with a single pair of carbons; we are informed that carbons giving 3,000 mean hemispherical candle-power have shown a running cost of less than $\frac{1}{10}$d. per hour on large installations.

The curve of illumination given on p. 539 shows that the maximum C.P. is over 4,000 at an angle of 15° below the horisontal, an exceptionally favourable feature for uniformity in street lighting; with 460 watts at the arc, the M.H.C.P. is 3,160, giving an efficiency of ·166 watt per M.H.C.P. The lamp can be burnt on direct or alternating current, taking normally eight amperes and burning two in series on 110 volts or four in series on 220 volts; it is equally efficient with five amperes direct on 110 volts or two in series on 220 volts. The company have made extensive additions to their factory and plant for manufacturing the lamps and special carbons, and have been enabled to reduce their prices in consequence of these improved facilities and increased output.

BUSINESS NOTES.

Manufactured Bitumen.—A novel invention has been brought to our notice, which will probably have important results in connection with the laying of underground mains on the "solid" system. Hitherto it has been necessary to employ the highest quality of Trinidad Lake refined bitumen for this purpose, in spite of its high cost; cheaper compounds have been tried, for the sake of economy, but with more or less unsatisfactory results. Mr. Thomas Marriott, of Kingston-on-Thames, however, has patented a system of manufacturing from pitch and an inexpensive mineral a compound which is physically and chemically analogous in almost all respects to the best Trinidad Lake bitumen, at a very much lower cost, and we understand that it is being supplied to central station engineers in large quantities, being found in every way suitable for the purpose of embedding electric cables.

The manufacturing process is carried out in the ordinary course of a tar distiller's business, and with the ordinary appliances; crude tar is refined, to free it from all substances deleterious to electric cables, such as naphtha, phenols and creosote, and the resulting pitch is mixed with a proportion of the last heavy distillate or other suitable flux; while the molten mixture is very hot, the mineral above-mentioned is added and thoroughly mixed with the bituminous matter. The resulting product, we are informed, is almost indistinguishable from lake bitumen, and its properties are under perfect control during manufacture, so that compounds suitable for either joint-box or trench-filling are readily produced to any specification. The artificial compound is called "Vulcobitumen," but is, of course, free from sulphur. No doubt it will soon be extensively adopted for laying mains, filling joint-boxes, and kindred purposes.

B.T.-H. Contracts.—The following is a list of some recent orders secured by the power and mining department of the British Thomson-Houston Co., Ltd., of Rugby:—

Braidwater Spinning Co., Ltd.—Fourteen three-phase motors, main switchboard, &c.

Purex, Ltd., Greenford.—One each 56 and 20-kw. generators; six D.C. motors, starting gear, lighting material.

Corlett Electrical Engineering Co.—Five D.C. motors and spares.

Carrongrove Paper Co., Ltd.—One 300-kw. D.C. generator; three three-phase motors, switchboard and wiring, &c.

Bennett Bros., London.—Twenty-seven D.C. motors and rheostats; eight A.C. motors and rheostats.

Williams, Harvey & Co., Ltd., Cornwall.—Five D.C. motors from 6 to 30 H.P., switchgear, &c.

Walter Somers & Co., Ltd, Birmingham.—Three each 30 and 15-H.P. D.C. motors and rheostats.

Steel, Peech & Tozer.—Thirteen motors from 5 to 100 H.P.

Scott's Shipbuilding and Engineering Co., Ltd., Greenock.—Eight D.C. motors from 10 to 120 H.P., with controlling and switchgear.

Glasgow Corporation, Glasgow.—Three D.C. motors from 40 to 80 H.P. and switchgear.

Powell Duffryn Steam Coal Co., Ltd., Aberdare.—Ten three-phase motors from 5 to 30 H.P.

G. Whitehead & Co., Ltd., New Eltham.—Two three-phase 25 and 110-H.P. motors, switchgear and wiring.

Clarke, Chapman & Co., Ltd.—Two three-phase 100 and 200-H.P. motors and switchgear.

Reavell Compressors.—Amongst many recent orders received by Messrs Reavell & Co., Ltd., is one for an electrically-driven compressor for the Borough of Rotherham, for supplying air to the various pneumatic sewage ejectors in the borough. The machine has a large range of variation in speed, which is controlled by hand. It is also fitted with two special air relay devices, one set for the maximum pressure and the other for the minimum pressure, which automatically operate a whistle when the pressure reaches either limit. The firm are also supplying a large machine of the quadruplex double-ended type to the order of the General Post Office for pneumatic despatch at the Central Post Office. Each end of the machine has a device for automatically controlling the volume, and may be used for either vacuum or pressure.

Brussels Exhibition, 1910.—Mr. F. B. O. Hawes, the secretary of the National Electrical Manufacturers' Association (Incorporated) writes as follows:—"I beg to inform you that the chairman of the Committee of this Association has just returned from Brussels, and desires me to point out to you the importance of this Exhibition commencing in April next year. This will be the most important Exhibition which has been held on the Continent since that at Paris. I would remind you of my letter of July 28th last, in which attention was drawn to some of the directions in which this Association can be of use to exhibitors, and beyond those mentioned is the matter of insurance, regarding which our expert wishes me to point out to members the necessity of making special arrangements jointly."

Catalogues and Lists.—Messrs. J. Tylor & Sons, Ltd., Belle Isle, York Road, London, N.—20-page pamphlet containing fully illustrated particulars and prices of their petrol engines for commercial vehicles, pumping, and other purposes, including electric lighting installations. An 8½-kw. Tylor petrol-electric plant is shown. A testimonial from a user in Bangkok concerning one of these sets is quoted.

British Thomson-Houston Co., Ltd., Rugby.—Price list No. 222, in the firm's standard style, giving descriptive particulars, together with tabulated sizes, speeds, prices, weights, &c., of a new line of continuous-current motors and generators, which they are introducing to the market.

Messrs. W. Geipel & Co., St. Thomas's Street, S.E.—Notice of increase of prices of high-grade v.i.r. cables, consequent upon the rise in rubber.

Mr. G. Braulik, 8, Lambeth Hill, E.C.—Circular describing a household apparatus (the Lahmeyer) for the ozonisation of drinking water. A sample apparatus may be seen working in Mr. Braulik's showroom.

The Electrical Co., Ltd., Lamp Department, 121/125 Charing Cross Road, W.C.—Price leaflet of Aegma miniature lamps for use with accumulators.

Messrs. Laurence, Scott & Co., Ltd., Gothic Works, Norwich.—List No. M 40 (12 pages) containing full specification particulars with tabulated data, prices and dimensional information, of their adjustable speed motors, semi and totally enclosed, 200 to 500 volts. The firm have specialised for some years in adjustable speed motors for direct-driven tools, and the information has been specially prepared for the convenience of machine-tool makers.

The Rugby Lamp Co, Ltd., Lower Hillmorton Road, Rugby.—Eight-page list just issued describing and giving prices, and showing actual size illustrations, of the Rugby metal and carbon-filament incandescent lamps, which are made in the specially-equipped factory at the above address.

General Electric Co., Ltd., 71, Queen Victoria Street, London, E.C.—The never-failing fertility of the G.E.C. publicity genius has yielded another crop of literature relating to Osrams. One of the picture postcards strikes home very forcibly with the information that Osram lamps save three-quarters of your electric light bill—it used to be 70 per cent., but a little more or less matters not, so long as you get the fact home that the saving is substantial. A second card tells us not to worry about the Daylight Saving Bill when the Osram is at hand to save our electric light bill. A folding leaflet tells of the reduced prices for the lamps, and many useful points concerning them, and the trade customer can have his own name and address printed on copies of these. The G.E.C. portable cost indicators, for showing at a glance in £ s. d. the saving effected, form the subject of another card. The other item in this batch is a 12-page pamphlet (No. S1,340), in which appear views of public buildings in London, Manchester and elsewhere, which are using Osram lamps. Reduced prices are indicated here also, and some testimonials showing economies effected by consumers are published. Some idea of the popularising campaign of the G.E.C., and the demand that exists for Osram circulars, may be gained from the fact that during September over 600,000 of these folders were printed, while further matter of a similar kind has had to be prepared for October.

The Electrical and Engineering Supplies Co., Ltd., 36/37, Upper Thames Street, E.C.—Neat binding cover containing pamphlets giving full particulars of the construction, efficiency, weight and price of their "Lloyd" continuous current dynamos and motors, the frames of which are of cast-steel, and the pole-pieces of laminated steel. Illustrations of complete machines of various types and of parts are included, showing method of construction, connection and dimension diagrams, &c. Prices and particulars of starters, shunt regulators, &c., are also given. Further lists for inclusion in this cover are shortly to be issued of larger direct-current, and single, two and three-phase machines.

Messrs. Chas. Joyner & Co., Ltd., Birmingham.—Illustrated leaflet, showing in colour their cord absorber fittings and giving prices of same; also a price list of the "Premier" switch.

Mr. E. Atkinson Smith, 70, Victoria Street, S.W.—Leaflet containing brief description, with prices, of the "Primus" stationary vertical type crude-oil engines.

The Cable Accessories Co., Ltd., Britannia Steel Works, Tividale, Tipton.—16-page pamphlet, giving prices and numerous illustrations of their cast-iron water-tight electric light fittings, &c., for collieries, factories, mills, and so on.

Messrs. Imeson, Finch & Co. Ltd., Bridge Works, Stockton-on-Tees.—Leaflet giving an illustrated description of Imeson's improved "Tell-tale" for collieries.

Messrs. Cutting Bros., Ltd., Park Works, Stamford.—Price card of electric motors of from ¼ to 30 H.P.

Mr. George Ellison, Victoria Works, Warstone Lane, Birmingham.—Circular briefly describing and showing oil-break circuit-breakers combined with A.C. starters for motor panels; also one of his monthly attractive publicity cards which always interest us.

Messrs. Drake & Gorham, Ltd, 66, Victoria Street, London, S.W.—A new catalogue has been issued by the firm this week, consisting of a large number of pamphlets describing the numerous electrical lines which they manufacture or in which they trade. The principal contents of the book, which is well a produced and full and bulky publication, are as follows: Tantalum lamps, "Osram" and carbon-filament lamps, flame and enclosed arc lamps, Jandus lamp accessories, auto-transformers, conduits and fittings; switchboards, switchgear and accessories; fuses and fuseboards; Nevile automatic accumulator switches; Quartz (Bastian) electric radiators. A good variety of electric light fittings for inside and outside purposes in all classes of buildings, glassware, reflectors, and so forth, occupy the concluding portion of the catalogue. The manufactures are all effectively illustrated.

The Tudor Accumulator Co., Ltd., 119, Victoria Street, S.W. New illustrated export catalogue of Tudor accumulators (72 pages), in the compilation of which special effort has been to provide all the data necessary to enable intending purchasers to prepare the preliminary work connected with the Tudor battery plants without previously referring to the company. As a guide in preparing estimates, examples are given containing all items essential for a complete and up-to-date battery plant, and they also show the manner in which prices are made up. Further, to enable clients to calculate approximately the freight of a battery from English to foreign port, tables of approximate weight and cubage of batteries, composed of 60 cells, including accessories and spares, packed for shipment, for all the different types contained in the list, are given. A finger index divides the catalogue into sections. The different types of cells, with drawings of plates, showing sizes and method of mounting, are first covered, and particulars of accessories and spares, erection notes, acid, &c., follow with tabulated details concerning the J. and J.S. type cells and the Readyburnt cells. Remaining sections cover intermediate capacities and the dimensional, estimate, and shipping information to which allusion has already been made. The pictures at the opening of the book show the exterior view of the factory at Dukinfield, an illustration of a large Tudor cell as supplied to Stockholm Electricity Works, and an interior view of the battery room at the Kolar mines power station, Oorgalum, India.

International Time Recording Co., 151/155, City Road, E.C.—Sixteen-page booklet, giving descriptive results of the use of their system of automatic time recorders in a number of different classes of business.

The Reason Manufacturing Co., Ltd., Lewes Road, Brighton.—36-page catalogue, fully describing, and illustrating with neat half-tones, and in some cases with diagrams, the Clark Fisher galvanometers and some other manufactures. The contents include the Column D'Arsonval galvanometer, the Stump, Wall, Pivoted and Broca and Kelvin galvanometers. There is a table of galvanometer sensibilities, and particulars are given of galvanometer accessories and shunts. Flux standards and condensers, standard cells, lanterns, brackets, testers, single-pivot indicators, reversers, tappers, &c., are also in the list.

Time Switches.—We reference to the tenders recently referred to in our pages for street lighting equipment for Swansea, we understand that Messrs. Venner & Co. are sub-contractors to Messrs. Lucy & Co. for the time switches for controlling this new street lighting scheme. For the Leyton street lighting contract, to which allusion was made in our last issue, 100 Venner time switches are also included as a sub-contract.

France.—A new company has just been formed in Paris, with a capital of £6 000, and the title La Société des Accumulateurs et Lampes "Trin," to acquire and exploit the French patent rights in the Trin accumulator.

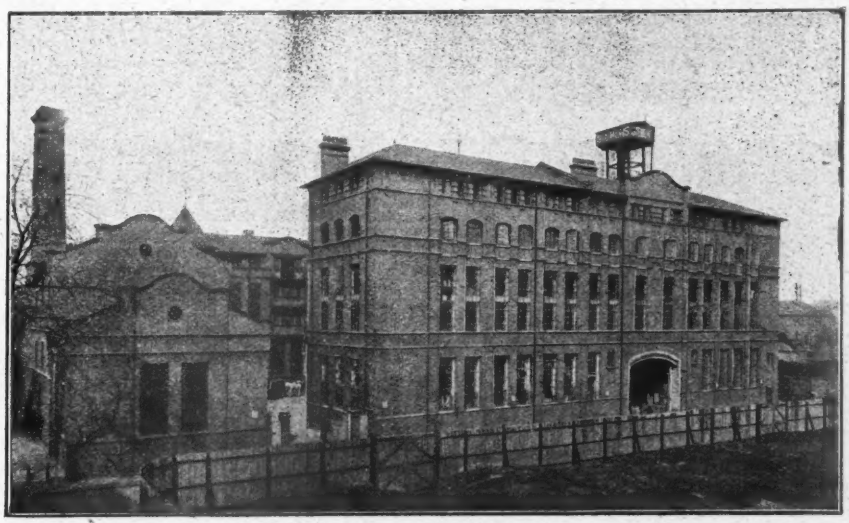
Blériot and Hoffman's Bearings.—We learn that the 60-H.P. engine which secured the world's record for speed for Mons. L. Blériot's monoplane at Rheims on August 28th was fitted with Hoffmann ball bearings. In spite of the engine being burnt after the accident which occurred, the bearings were in perfect condition, and it was therefore possible to fit the engine on a new monoplane.

Australia.—The Australian Customs authorities have recently given a decision to the effect that "Insulation stripbitite (a preparation of oxidised and vulcanised oils, with asphalt or pitch, but no rubber, used by electricians as an insulating tape) is dutiable at the rate of 5 per cent. *ad valorem* in the case of foreign material, that of English manufacture being admitted free of import duty."

Malay Rubber.—A Reuter dispatch from Singapore states that the value of the rubber exported from the Federated Malay States for the last eight months amounted to $3,500,000, as compared with $2,000,000 in the corresponding period last year.

Norwegian Ironworks. — A company, named the Norwegian Electrometall, has just been registered at Christiania with a capital of kr. 300,000 (£16,666) for the purpose of erecting a combined iron and steelworks in the near future, using an electrical process for the smelting of the ore.

The Tantalum Lamp Works at Dalston.—When lamps are the subject of conversation everywhere in electrical circles, and lamp factories for the manufacture of metal-filament lamps are getting to work, it will probably interest many of our readers to see the accompanying view of important premises, where a very large number of lamps is handled in the course of a year, in the North of London. They are the English Tantalum lamp works of the firm of Siemens Bros. Dynamo Works, Ltd, of Tyssen Street, Dalston, and are a few steps from the Dalston Junction station of the North London Railway. As on the occasion of a recent visit we were impressed by the extent of the premises required for the company's tantalum operations in London, we publish this view in the belief that our readers will be similarly impressed.



Tantalum Lamp Factory at Dalston.

Trade Announcements.—The Adnil Electric Co., Ltd. (late Marples, Leach & Co., Ltd.), have appointed Mr. J. B. Chambers, engineer and representative for the Yorkshire district. Mr. Chambers has been connected with the engineering department of the firm for some years past, and he will advise on, and quote for, electric power and lighting installations in the district mentioned. His present address is 76, Hill Top Mount, Roundhay Road, Leeds.

Messrs. Arthur L. Gibson & Co., announce that in order to concentrate all departments of their business, they have removed their offices and warehouse to the works at Twickenham. All communications should now be addressed to the firm at Radnor Works, Strawberry Vale, Twickenham.

The works of the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Silvertown, are closed to-day and to-morrow for stocktaking purposes.

The Beck Flame Lamp, Ltd., have removed their offices to Suffolk House, Laurence Pountney Hill, Cannon Street, E.C., and all communications should be addressed there, except advice notes of goods dispatched or empties returned, and replies to letters emanating from the works, which should be addressed to the company at their works, Hayes, Middlesex.

Messrs. J. & H. Grevener have now taken over the Electromotor and Dynamo Co, of 15, Gray's Inn Road, dating from October 1st. Communications relating to the business of the Electromotor and Dynamo Co. should now be forwarded to Messrs. Grevener. The new branch of their business is still being conducted under the supervision of the late manager of the Electromotor and Dynamo Co. In addition to their "Arcoflame" lamp, Messrs. Grevener are supplying motors, generators, transformers and controllers.

Book Notices.—"Les Essais Mécaniques du Caoutchouc et des Tissus." By P. Breuil. Paper presented to the International Congress for Testing Materials, Copenhagen, 1909. Paris: Le Caoutchouc et la Gutta-Percha. In this paper the author describes the apparatus which he has invented for testing the mechanical properties of rubber—namely, a dynamometer and an "elastodurometer." With these instruments a variety of tests can be made in the minimum of time. M. Breuil is to be congratulated on his praiseworthy endeavours to place this difficult subject on the scientific basis of exact measurement.

Engineering Units of Measurement. By John Ramsay, A.M.I.C.E. Glasgow: John Smith & Son. Price 1s. net. 1909.—This booklet brings together in convenient form the units employed in engineering, physics, &c., with definitions and brief explanations of their uses and relations. The treatment includes in many cases the definition of the quantities with which the units are connected, and covers a great deal more than might be inferred from the title, such as physical laws, symbols, abbreviations, British and metric equivalents, and a number of useful tables of physical data, &c. Insufficient attention has, we think, been given to thermal units, which are found only in a table; the properties of steam might also be inserted, though not strictly included in the subject. We note that the author wrestles manfully with the confusion between gravitational and absolute units, with fair success, though we fear that the young student will meet with difficulties in disentangling the two systems. Why introduce the poundal at all? It is never used—except to puzzle young brains (and not seldom old ones, too). The booklet may be commended as a very useful production.

We have before us a copy of the Special Diamond Jubilee number of the *Iron and Steel Trades Journal*. We congratulate our contemporary on its great age, and on its success, as we do also upon the production of a very interesting commemorative number.

Another contemporary which can justly claim our congratulations, and one with which we are perhaps more familiar, is the *Ironmonger*, which, with its issue of September 4th, began its fifty-first year. The occasion was celebrated by the publication of a special issue containing a great deal of interesting matter regarding the past history of the paper, its proprietors and other *personnel*, its policy, and so forth.

Our contemporary, *Concrete and Constructional Engineering*, which has hitherto appeared as a bi-monthly, will in future be published every month. The change began with the September issue, and marks the rapid progress that has recently been made in the science and art of this important subject. One of the articles deals with a reinforced concrete engine room at Frankfort.

"Elementary Electrical Calculations." By T. O'Conor Sloane. London: Crosby Lockwood & Son. Price 9s. net.

Liquidation. — General International Wireless Telegraph and Telephone Co., Ltd.—A meeting is to be held at 110, Cannon Street, E.C., on October 26th, to hear an account of the winding up from the liquidator, Mr. W. H. Dove.

Bankruptcy Proceedings.—E. F. Jones, plumber and electrical engineer, Hartlepool.—First meeting, October 6th; public examination, October 7th; both at Sunderland.

L. W. de Grave, electrical engineer, Darby.—First and final dividend of 4s. 3½d., payable at the Official Receiver's Offices, Derby.

Model Engineering Exhibition at Westminster.—This Exhibition, which opens at the Royal Horticultural Hall, Westminster, S.W., on Friday, October 15th, will, we are informed, contain some exceptionally interesting exhibits. There will be a number of model aeroplanes on view, including the machine designed by Mr. G. P. Smith, which won the gold medal in the recent contest at Wembley Park. Working model steam and electric railways, electric clocks, light machine tools, model motor boats, a model engineers' workshop in operation, and a working demonstration of wireless telegraphy by the latest Marconi apparatus, are some of the numerous attractions which will be presented; while in the competitions for engineering and electrical model making over 100 entries have been received. The Exhibition will remain open for eight days, from 12 noon till 10 p.m., closing on Saturday, October 23rd.

LIGHTING and POWER NOTES.

Acton.—At the last meeting of the District Council, the following motion was passed:—"That the maximum demand system, based on the load factor for power and heat, would be fairer to the Council and the consumers than the flat rate now in force, and that it be referred, together with the engineer's report, to the Electricity Committee to fix the charge." Mr. Monson, the chairman of the Electricity Committee, said that it was quite clear they must not continue to sell at the prices they had been doing if they wished to make the undertaking pay. The great loss last year was caused, to a large extent, by some of the consumers taking current when the load was at its greatest. Mr. Schultess Young proposed that negotiations be re-opened with the Metropolitan Electric Supply Co. for the taking over of the undertaking, and that in the event of certain replies of the company being favourable, a referendum of the ratepayers be taken on the question of disposing of the undertaking. Six voted for the motion and six against; it was, therefore, not carried. An application was considered from Messrs. Warren & Beck for a supply of current for power purposes in connection with their compressed gas plant in High Street. The firm is to be informed that the Council is prepared to give a supply, but that the rate of charges must be considered at the next meeting of the Electricity Committee.

Australia.—The Inverell (N.S.W.) Municipal Council has adopted a report recommending the provision of an electric supply at a cost of £10,840. This would provide 25,700 c.p. for street lighting, and the price for public supply would be 6d. per unit for lighting and 3d. per unit for power. The Sydney (N.S.W.) Council has under consideration a system of charging during certain fixed hours of the day, viz., 1½d. per unit for a minimum of 20,600 units per annum. The engineer explained that the system applied to consumers who were prepared to install accumulators for use during the peak load, which would be charged during the day.

Bedford.—The T.C. has decided to apply to the L.G.B. for a loan of £630 for a scheme of street lighting by electricity.

Bexhill.—The Council has appointed a sub-committee to consider the question of holding an electrical exhibition in the autumn. An exhibition held some years ago resulted in many new customers being obtained.

Bispham.—The U.D.C. has instructed Mr. J. W. Speight, of St. Anne's, to submit a scheme of electric lighting for the district.

Brazil.—The Rio de Janeiro Tramway, Light and Power Co. has opened a new sub-station at Meyer for supplying electricity to the new Caxomby tramway system and for general use. Another sub-station is being erected at Cascadura, and a supply is to be given to the cotton mills at Bangu and the military town of Sapopemba. A judicial decision has been given in the action brought against the company and municipality by Guinle and Co., asking that the privileges given to the company by the municipality should be declared void. Messrs. Guinle have for some time been endeavouring to obtain authority to distribute electrical energy in Rio de Janeiro, but the decision recently recorded confirms the concessions of the Power Co. until 1915; after that date the municipality can concede similar rights to others if it should care to do so.

Brompton.—The Council schools at Brompton, near Northallerton, are to be lighted by electricity. Mr. J. P. Yeoman has offered to install the light if the Committee pays him 6d. per unit for energy, and this offer has been accepted.

Castleford.—The U.D.C. has decided to apply for a prov. order for electric lighting. This step has been taken in opposition to a monopoly being secured by the Electrical Distribution of Yorkshire, Ltd., which is applying for an extension of time for supplying the district, which is promised a supply early next year.

Chester.—Having considered the electrical engineer's report as to the effect of the present rule of allowing discount on the aggregate consumption of energy to persons or firms having two or more installations, the T.C. has decided to adjust the discount in these cases, and as from March 25th, 1910, each installation will be treated as a separate account, and discounted accordingly. In support of the Council's action in disturbing existing arrangements, on the faith of which, doubtless, many customers have become users of electric light, it may be stated that the present price is only 3½d., as compared with 5d. or 6d. when the discount arrangement was entered into.

Congleton.—The B. of G. has decided to ascertain the cost of lighting the workhouse by electricity.

Continental Notes.—Norway.—In the Norwegian Storthing, a proposition was recently submitted by the Government asking for a sum of 185,000 kroner (£10,300) for the purchase of the rights of the Tafjords river in Norddalen in Ramsdalen, in the western part of Norway. The total power in the river is estimated at 20,450 h.p. in five waterfalls. The expenditure in connection with harnessing these falls is estimated at 1 million kroner (£55,555), in addition to the cost of the generating plant, &c.

The municipality of Kragero has decided to erect municipal electrical works, receiving power from the Norwegian Electrochemical Co.'s generating station at Slitnastangen, not far from the town. The estimate for the whole plant amounts to 150,000 kr. (£8,333), for which sum a loan is to be raised.

The Norwegian Metalindustry Co. has applied for a concession to take over the present Sundlökken Zinc Smelting Works, situated in Borge. The new company, which has a capital of 500,000 kr. (£28,333) intends to exploit Norwegian ore deposits and mines, and has already made a contract with the Hafslund Electrical Works for 2,000 h.p. at a rent of 90,000 kr. (£5,000) per annum.

Sweden. — The Västerdalälfens Power Co. is erecting a power station in the neighbourhood of Moekfjärd with the view of utilising 16,000 h.p. from the waterfalls of Lillstup and Storstup in the Västra Dalriver. For a start it is intended to install two generators with a capacity of 4,000 h.p. each, which in the future will be connected with two others of similar size. The bulk of the energy will be transmitted to the large manufactories of the Grängesberg, and the Stora Kopperbergs companies in Bergslagen by means of three-phase current at 50,000 volts. The contract for the electrical plant has been given to the Nya Förenade Electrical Co., and the amount in question is said to exceed £50,000.

Coventry.—The City Council on Tuesday approved the following system of charging for the use of radiators from lighting circuits:—The accounts of consumers having radiators and taking energy from the lighting circuit to be averaged for a period of two years, this average to be taken as the lighting account and charged at the ordinary rate, and all units in excess of this to be taken as the heating account, and to be charged at the power rate.

Doncaster.—The R.D.C. has accepted the offer of the T.C. to light Bentley Road by electricity at £3 per lamp per annum, and £1 19s. extra where double lights are necessary.

Gillingham (Kent).—The T.C. has appointed Mr. J. F. C. Snell, of Westminster, at a fee of 150 guineas, to investigate the working of the electricity undertaking, in accordance with the suggestion of the L.G.B.

Gravesend.—The T.C. has referred back for further consideration a proposal to extend the mains to the adjoining parish of Denton. The Electricity Committee had recommended that the extension should not be undertaken at present owing to the heavy cost.

Greenock.—An exhibition, inaugurated by the electricity department, was held in the Town Hall last week. Complimentary tickets were issued by the department, but owing to the great demand for them, a charge was imposed on the last day. Nearly 10,000 people visited the exhibition, which has resulted in numerous inquiries and substantial orders for electrical apparatus.

India.—According to an American paper, the possibility of supplying hydro-electric power to Calcutta is being reconsidered in view of the survey of a series of falls in the State of Mourbhanj, 140 miles from the city, where it is considered that up to 70,000 H.P. could be obtained.

Kingsbury.—Mr. Jose Diaz, the Chairman of the local Council, reported at the first meeting after the recess that he had written to the North Metropolitan Electric Power Supply Co., to the effect that he had ascertained that a large number of the residents were anxious to be supplied with energy, and some had actually had their houses wired and fitted up for that purpose.

Leicester.—A loan of £7,000 for cables and works in connection with the supply of energy from the tramways generating station for power, &c., has been applied for by the Council.

Leyton.—The estimates for the half-year ending March 31st next having been reconsidered, the estimated deficiency for the six months on the electricity undertaking has been reduced from £419 to £393, which latter amount will be met from the surplus of £2,353 from the preceding half-year, leaving an estimated net surplus for the year ending March 31st next of £1,960. Of this amount, £500 is to be placed to the credit of the reserve fund and the balance of £1,460 is to be applied in relief of the rates.

London.—At the meeting on September 23rd of the Court of Common Council, the County of London Electric Supply Co. gave notice of its intention to commence the laying of extra high-pressure electric mains and iron conduits across London Bridge and the City to the boundary of Finsbury. Mr. Wilkinson said the work would cause a great disturbance in the eastern part of the City. He asked what was the power of the company in the matter. —The City Solicitor (Sir Homewood Crawford) said if the route suggested was disapproved of, the Corporation would have to submit an alternative one, and if that was not accepted by the company, an arbitrator, appointed by the B. of T., would have to be called in to say what route should be taken. Mr. Turner said the question had been under consideration by the Streets Committee, and that Committee was so impressed with the importance of the matter, that it was going to call a special meeting of the Committee shortly. The subject then dropped.

HAMPSTEAD.—The income from the electricity undertaking for the year ending Lady Day amounted to £63,197. At the last meeting of the Council, Alderman Pritchard said he considered the foregoing figures were quite satisfactory. The deficiency caused in the income owing to the general introduction of metallic-filament lamps had now almost been made up by the increased number of new consumers. There had also been an increased number of consumers of current for heat and power, and this increase was, of course, especially gratifying.

Malvern.—At the Malvern College and College Master's Houses, an installation comprising over 600 metallic-filament lamps has just been installed upon the advice of Mr. W. J. Rendell Baker, electrical engineer to the Council, who prepared all specifications, &c., the work being carried out by the local firm of Mr. A. Sparkes.

Melbourne.—The P.C. has under consideration an electricity scheme, proposed by Mr. John Jardine, of Nottingham, who intends to erect large works in the parish, and from them to supply electricity under a suggested prov. order.

Mexico.—According to reports from the Mexican Government, the damage to the Necaxa Dam by the accident of May 20th last, can be rectified by the expenditure of £50,000; the work of repair is so far advanced that the power company's supply is maintained from the hydro-electric plants.

Newport.—It was reported at a meeting of the Electricity and Tramways Committee on Tuesday last that it had been decided to call in Mr. Parkes to investigate and report upon the electricity undertaking. It was decided at the same meeting that the engineer should make inquiries from the B. of T. as to whether trailers could be attached to the cars at Newport. It is hoped that, by the use of trailers, the revenue of the cars may be considerably increased by a proportionately small capital expenditure. Mr. Parkes will report upon this and other suggestions for increasing the net revenue.

Plymouth.—The Electricity Committee of the T.C. has received from the borough treasurer the financial statement of the electricity undertaking for the year ended March 31st last. It shows a total income of £23,596, of which £23,331 was received from the sale of current. On the debit side the expenditure amounted to £12,394. After meeting this charge, there remained a gross profit of £11,562, which was carried to the net revenue account. Out of this account, payments were made for dividend and interest and stock redemption, leaving a net profit of £2,232, of which £1,991 was paid over in relief of rates, and £241 carried to the reserve fund. At the end of the financial year, the reserve fund stood at £10,193. On capital account during the year, £8,504 was raised by new loans, and £6,912 spent on machinery, plant, and mains, leaving a balance of £1,592 to be carried forward.

Runcorn.—The Castner-Kellner Alkali Co., Ltd., which is applying for a prov. order for electric supply in the area of the U.D.C. and the township of Weston in the area of the R.D.C., has submitted to the U.D.C. a draft of the order. This states that the whole of both towns is scheduled, and the proposed charges for supply are:—Up to 20 units 10s., and 6d. per unit beyond. The U.D.C. has referred the matter to a special committee.

Southampton.—The T.C. has received from the L.G.B. sanction to loans of £2,300 for mains and £700 for services.

Southend-on-Sea.—The T.C. has decided to apply for a loan of £13,715 for the provision of two sub-stations, with cables, batteries, &c., near Chalkwell Park and the Thorpe Hall Estate.

Extensions of mains have been authorised, including feeders and cables to the district between High Street and Southchurch Avenue, the latter at a cost of £2,400.

Tonbridge.—The U.D.C. has decided to utilise electricity for pumping purposes at the sewage disposal works. Energy will be supplied by the Electricity Committee of the Council at ½d. per unit.

Walthamstow.—The Lighting Committee having gone into the question of public lighting, has decided in favour of an application being made to the L.G.B. for sanction to borrow £9,036, the estimated cost of converting 921 gas lamps to electricity. During July and August 502,748 units were generated, as against 457,054 in the corresponding period of last year. There was a decrease of nearly 8,000 units for traction, but there was a great increase in other directions.

West Ham.—An agreement has been entered into to supply energy to the works of the Avenue Press, Ltd., including the hire of motors and apparatus, for a period of five years, with the option of renewal for a further five years; also for a bulk supply to the Bradford Rubber Co. for five years, renewable at termination to seven, 14 or 21 years. The last-named company has agreed to hire the motors from, and for the necessary works to be carried out by, the Council. Negotiations have taken place with the chief engineer to the Port of London Authority for a bulk supply to the Royal Albert and Victoria Docks. Having regard to the Electric Lighting Acts Amendment Bill now before Parliament, the town clerk has been authorised to communicate with the East Ham and North Woolwich Councils with a view to obtaining their consent to the supply of current by the West Ham Council for use within their respective areas.

TRAMWAY and RAILWAY NOTES.

Bradford.—The Tramways Committee has for some time had under consideration the question of bringing the depôts for the accommodation of the cars thoroughly up to date, and it is faced with the task of having to erect permanent buildings in place of some of the present temporary structures or of adopting the scheme of the manager, Mr. C. J. Spencer, for the provision of a large depôt near the centre of the city. A suitable site in the Longlands area is available for this latter purpose, and Mr. Spencer has calculated that if a depôt were erected there, a saving of 56,394 car-miles per annum of "dead mileage" would be effected. At present there are nine depôts, and they provide storage for 275 cars. If the present policy is continued an outlay of £22,468 on new depôts will have to be provided for, and it is claimed that the saving in dead mileage and in administration with a central depôt would amount to £1,787 per annum, which represents a capital sum in providing interest and sinking fund of £29,783. This, added to the £22,468, amounts to £52,251, whilst the acquisition of the Longlands site (over 9,000 yd., at £1 per yd.) and a building to accommodate 150 cars, would cost £46,500. Mr. Spencer's scheme would entail the abandonment of the Bolton, Lidget Green, Fairweather Green, and possibly the Duckworth Lane depôts, which would mean, of course, that the cars would not run nearly so late on those sections as at present. The Tramways Committee visited some of the depôts and considered the scheme, and we understand that it decided to recommend the City Council to adopt it.

Continental Notes.—RUSSIA.—According to the *Financier*, nearly all the Russian tramway enterprises are in the hands of Belgians. Out of 40 tramway systems either at work or under construction 34 belong to Belgians, and three only to the French. Out of 1,312 versts (about 875 miles) of tramway track in Russia 1,086 versts, or over 80 per cent., belong to foreigners, and the remaining 226 versts are either worked by municipalities or by Russian concessionaires. Five Belgian trusts exist, which have

bought up 23 Russian tramway systems. These trusts operate in Taschken, Astrachan, Kischeneff, Kazan, Moscow, Odessa, Kieff and elsewhere.

The municipal authorities of Suchum are considering a project for the construction of an electric tramway in the town.

GREECE.—According to a daily paper, all the tramway employés in Athens are on strike, and no cars are running.

Dublin-Dalkey.—Last week Col. von Donop, of the B. of T., made an inspection of the line of the Dublin United Tramways Co. from the city boundary of Dublin to Dalkey, over portions of which the company is seeking powers to run some of its cars at increased speed. Representatives of the company, the city and the township were present.

Dundee.—The Council is considering the question of acquiring a petrol-motor tower wagon for use in connection with the maintenance of the overhead conductors of the electric tramways.

Dunfermline.—It is expected that the Dunfermline and West of Fife tramways will be running next month. The laying of the track has almost been completed, but the overhead wires have still to be placed.

Haslingden.—The T.C. on September 23rd considered the great inconvenience to the tram-using public, and the serious loss occasioned to the Corporations of both Haslingden and Rawtenstall by the necessity imposed upon passengers travelling between the two towns, a distance of two miles, to change cars at Lockgate, on the boundary. The Tramways Committee recommended that a further effort should be made for the solution of the deadlock by seeking a joint conference of three representatives from the three boroughs of Accrington, Haslingden and Rawtenstall with a view to devising means to put an end to the present state of affairs. If no mutual and satisfactory agreement could be arrived at, it suggests that the B. of T. should be asked to adjudicate, and that the three authorities should be asked to abide by the Board's decision. The representatives attending the proposed conference should have full power to deal with the matter of through running.

Leeds.—The Tramways Committee has instructed the town clerk to take steps to promote a Bill for the equipment of certain routes on the railless trolley system. The present idea is to establish a route from the city square to Farnley.

London.—A scheme is under consideration for linking up the Crystal Palace with Victoria by a tube railway, having a capital of £3,500,000. The distance to be covered is about eight miles, and it is suggested that the net construction cost, including land and equipment, will be about £340,000 per mile, as compared with from £600,000 to £800,000 per mile in the case of some recently constructed London tubes. Needless to add, the estimates are of a favourable kind.

The L.C.C. proposes to proceed immediately with conduit tramways from Rainton Road, Greenwich, to Woolwich Dockyard. It was also proposed to extend the trolley line from Beresford Square to the Ferry, but the Astronomer Royal having withheld his consent owing to the proximity of the Observatory, it appears that some other system will have to be adopted.

The date of opening of the Brighton Co.'s London Bridge-Victoria electrical section has been further deferred until December 1st. The postponement is stated to be due to a necessary rearrangement of the signals into London Bridge. Experimental trains are being run daily between Peckham Rye and Battersea.

HAMPSTEAD.—At the first meeting of the B.C. this session, a memorial signed by 1,800 residents was presented, asking the Council to oppose the proposal of the L.C.C. to lay tramways along Adelaide and Finchley Roads. The matter was referred to the General Purposes Committee for consideration.

A new goods receiving depôt is being opened by the Metropolitan Railway at Farringdon Street, and it is intended to inaugurate a through goods service for market garden produce from Verney Junction to the City over the electrified lines.

At the annual meeting of the Holloway Ratepayers' Association recently, a resolution was passed protesting against the proposed L.C.C. tramway extension from Seven Sisters' Road *via* Tollington Park to Crouch Hill.

Musselburgh.—The recent alterations in fares by the tramway company have aroused great opposition in the town. A public meeting of protest attended by 700 persons was held on September 23rd, when a resolution requesting that the old fares may be reintroduced was passed.

TELEGRAPH and TELEPHONE NOTES.

Cable Interruptions and Repairs:—

	Interrupted.	Repaired.
Tangier-Cadiz	May 19, 1909	September 21
Tourane-Amoy	June 17, 1909	
Assab-Perim	July 8, 1909	
Dakar-Conakry	Aug. 20, 1909	
Balikpapan-Kwandang	Sept. 2, 1909	
Cheiksaid-Perim	Sept. 15, 1909	
Hong Kong-Macao	Sept. 25, 1909	

Wireless Telephony.—An installation of wireless telephony, invented by Mr. Andrew Burns, Portobello, has been erected at Portobello Pier, and last week a practical demonstration was given. The stations on the pier are a quarter of a mile apart, and speech was heard quite distinctly.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—VICTORIA.—100,000 porcelain insulators for the P.M.G. See "Official Notices" September 10th.

VICTORIA.—Accumulators for the P.M.G. See "Official Notices" to-day.

Telegraph and telephone material for the P.M.G., Melbourne. See "Official Notices" September 10th.

Common-battery switchboard for the North Sydney Telephone Exchange. See "Official Notices" September 10th.

MELBOURNE.—50 coin attachments, suitable for coins of different value, for the P.M.G. See our "Official Notices" September 24th.

Brumby and Frodingham.—October 16th. Public lighting by electricity for the U.D.C., with 55 50-C.P. lamps, poles, wiring, switches, &c.; direct-current, 220 volts, available. Mr. J. Green, surveyor to the Council, Frodingham, Scunthorpe, Lincs. Returnable deposit, 10s. 6d.

Dartford.—October 13th. Wiring the Council Chamber and offices for the U.D.C. Electrical Engineer, Electricity Works, Dartford.

Dundee.—The Corporation electrical engineer has been instructed to draw up specifications and obtain quotations from manufacturers in connection with the proposed motor-repairing wagon.

France.—October 11th. The municipal authorities at Meudon are inviting tenders for the supply of four sets of engines and dynamos for the Military Balloon Station at that place.

Glasgow.—October 4th. The Corporation invites tenders for the general supply, delivery and erection of mains, switchboards, distribution boards, cables, switches, &c., wiring and accessories for transmission of electrical power to motors, &c., and for lighting at their Shieldhall sewage purification works. Specifications from the Office of Public Works, 64, Cochrane Street, Glasgow.

Keighley.—October 16th. Two boiler feed pumps, high-tension switchboard and transformers, 300-KW. motor-generator, and mains for the Electricity Department. See "Official Notices" to-day.

London.—October 4th. Electric wires and cables, lamps, carbons, switches, fuses, telephones, cells and electrical insulating materials for the Metropolitan Railway Co. for a year. W. H. Brown, secretary, 32, Westbourne Terrace, W.

Rotherham.—October 23rd. The T.C. has two steam dynamos, 32 KW. each, for disposal. See "Official Notices" September 24th.

Walthamstow.—Cable for interconnecting the large feeder at Higham Hill with the Blackhorse Lane feeder, for the Council's electricity department.

Worthing.—October 11th. Cables for the Corporation. See "Official Notices" to-day.

CLOSED.

Belfast.—From seven tenders received for the electric lighting of Purdysburn Lunatic Asylum, the Committee of Management has selected for acceptance that of Messrs. John Dowling and Sons, Belfast, at £460.

Bexhill.—Messrs. Siemens Bros.' tender of £121 for the supply of 1,000 yards of cable to Bexhill Corporation has been accepted.

Burnley.—At the meeting of the Board of Guardians on September 23rd, the half-yearly tenders were confirmed. These included electrical requirements by Messrs. Carter & Co.

Bury.—The Electricity Committee has accepted the tender of Messrs. Ferranti, Ltd., for the erection of the new switchboard gallery at the new power station at Chambers' Hall.

Cape Colony.—A contract has been signed between the authorities of H.M. Naval Yard, Simons Town, and Messrs. Cunningham & Gearing, engineers, of Cape Town, for the complete internal equipment for lighting and power of the new workshops

at Simons Town. The lighting includes the installation of 48 arc lamps, and the approximate wiring of 35 motors; the whole work to be carried out in cold-drawn galvanised steel conduit. All fuses, automatic cut-outs, meters, main switches, &c., will be enclosed in cast-iron boxes, manufactured by Messrs. Cunningham & Gearing in their works at Cape Town. In addition, the firm were also successful in securing the contract for the electric light installation of about 24 private residences attached to the Naval Yard. The whole work will be carried out under the personal supervision of Mr. R. Wightmann, electrical engineer, H.M. Naval Yard, Simons Town.

Hanley.—The T.C. has accepted the tender of the Brush Electrical Engineering Co., Ltd., for a motor-generator for the Town Hall lift, at £144.

Leyton.—The U.D.C. has accepted the tender of the Electrical Joint Box Co., at £307 10s., for 100 public lighting lanterns with clock switches. The list of tenders appeared in our pages last week.

Liverpool.—The D.P. Battery Co., Ltd., has received an order for the renewal of the large batteries at Waterloo owned by the Liverpool District Lighting Co., and their maintenance for a period of eight years.

London.—BATTERSEA.—The B.C. has accepted the following tenders (as per schedule prices) for the wiring and fitting-up of consumers' premises with arc lamps for electric lighting, and for the supply of goods in connection with the high-purchase scheme:—

Flame arc lamps.—Beck Flame Lamp, Ltd.
Enclosed arc lamps.—Brockie-Pell Arc Lamp Co.
Open-type motors.—British Westinghouse Electrical Co.
Arc lamp installations.—G. A. Gunn and Phillips & Co.
Motor installations.—Stegmann & Co., Phillips & Co. and J. W. Gunn.

ISLINGTON.—The B.C. has accepted the tender of the Steeplejack and Engineering Co., Nottingham, at £275, for repairing the shafts at the generating station.

Plymouth.—The T.C. has accepted the tender of the Brush Electrical Engineering Co. for a turbo-generator, at £2,244. The highest tender was £3,617.

Swansea.—The Executors of the Harbour Trust have left the tenders for the King's Dock Power Station and sub-stations in the hands of the chairman (Sir Griffith Thomas) and the officers, to settle after communication with the electrical firms tendering.

Tenders for the erection of a 3½-ton electrical crane for the larger warehouse at King's Dock were considered, and it was resolved to recommend the acceptance of that of Messrs. H. Morris & Co. (?), Loughborough, subject to that firm agreeing to sundry alterations.

West Ham.—The T.C. has placed the following orders for coal for the electricity undertaking:—

Messrs. E. Foster & Co.—5,000 tons Grangerigg Dry Peas for delivery between January and October next.
Messrs. Cory & Son.—33,000 tons of coal at a price not made public; also 800 tons of Lynwood Rough Slack, 11s. 6d. per ton.
Messrs. Speakman & Sons.—220 tons Yorkshire coking smalls, 11s. per ton; 76 tons Yorkshire nuts, 11s. 6d. per ton; 400 tons Shafton Yorkshire smalls, 10s. 4½d. per ton.

The Council has further placed an order with the Armorduct Manufacturing Co., for certain sizes of cable to cover the estimated requirements up to March 31st next.

FORTHCOMING EVENTS.

Institution of Mining Electrical Engineers.—Saturday, October 2nd. At 2 p.m. Council meeting at the Royal Victoria Station Hotel, Sheffield. A general meeting will be opened at 2.30 to report progress and announce preparations for the forthcoming winter session.

Society of Engineers.—Monday, October 4th. At 7.30 p.m. At Caxton Hall, S.W. Prize essay on "The Status of the Engineering Profession," by G. A. Thomas.

Civil and Mechanical Engineers' Society.—Thursday, October 7th. At 8 p.m. Presidential address by Mr. W. Noble Twelvetrees.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued for the week ending October 9th, 1909:—

Commanding Officer—COL. R. E. B. CROMPTON, C.B.

Monday, October 4th.—"A" Company. Technical drill, 7 to 9.30 p.m.
Tuesday, October 5th.—"B" Company. Technical drill, 7 to 9.30 p.m.
Wednesday, October 6th.—Gymnasium, 6.30 to 9.30 p.m.
Thursday, October 7th.—"C" Company. Technical drill, 7 to 9.30 p.m.
Friday, October 8th.—"D" Company. Technical drill, 7 to 9.30 p.m.

(Signed) P. H. CAMPBELL,
Capt. R.E. and Adjutant.
For O.C. E.E. (L.D.)

NOTES.

Inquiries.—Correspondents wish to know the addresses of the makers of "Wakefield's patent vaseline insulating oil"; of glow lamps fitted with Cleminson's patent porcelain caps; and of water-distilling apparatus.

Appointments Vacant.—Railway telegraph foreman for Ceylon Government Railway (£200). See our advertisement pages for particulars.

Miners and Electricity.—Mr. John Wilson, M.P., in his monthly report to the Durham miners, makes a very long reference to the Stanley disaster, and comments at length on the report of the Government Mine Inspectors. After quoting from the report, he says:—"With this cloud of witnesses and volume of testimony in favour of the Busty seam being the place of origination, then the assumption becomes a certainty and electricity a more likely first cause than any of the other alternatives which might present themselves as being causes of the explosion. If that be so, what, then, is our duty? If there were only a probable danger of electricity playing such a dangerous part in such a holocaust of human life with its consequent misery, is it not the duty of all to inquire closely into, and seek to provide against a recurrence of a similar, or any calamity of the same nature, if not in the same degree." Mr. Wilson added that all he was asking for was for an inquiry as to whether that new danger was real or not. The mind of the mining community was unsettled on that subject. This applied not only to the men but to the managers. It was that unrest that he wanted to allay. He welcomed any appliance, electric or otherwise, but let them have safety with it. If he had written on the subject it was with the desire to incite further inquiry, and he felt confident that none would be more ready to join in that desire than the gentlemen whose names were appended to the report. They knew the life of a miner, and were willing to make it as safe as the circumstances permitted, therefore the miners might hope that they would assist in procuring the inquiry he had suggested.

"Electrical Football League."—A Council meeting of the above was held at 19, Carnaby Street, on the 22nd ult., when the resignation of Mr. Fraser, the honorary secretary, was accepted, and a vote of thanks passed to him for the businesslike way in which he had conducted the League since its foundation in 1907. Mr. H. W. Roberts, of 71, Queen Victoria Street, E.C., has now taken over the duties of honorary secretary, assisted by Mr. Fraser as honorary referees' secretary. Future communications should be addressed to Mr. Roberts. The League comprises clubs attached to the various manufacturing and supply companies within a radius of 15 miles of Charing Cross; it is stated to be the only Football League which is exclusively attached to a particular industry, and it is hoped that it will receive hearty support from the trade, seeing that it has the object of promoting friendly rivalry and sociability amongst the employés of the various Companies and Municipal Electric Supply Stations. The season opens on Saturday next, the 2nd inst., when the County of London Electric visits the St. James' and Pall Mall Electric.

Curious Lightning Incident.—During the storm which did a considerable amount of damage in various parts of the country on Friday last week, three cows were struck dead by lightning in a field connected with Broomhall Farm, Sunningdale, Berks. It has now been asserted that the lightning was attracted to the spot by a piece of disused wire, put up many years ago for either telephonic or telegraphic purposes. This wire was stretched along the tops of three oak trees, and was not properly earthed. The tree at one end was split almost in two, and the cows were standing under the middle tree, which was also struck, when they were killed.

Robertson Fire Brigade Successes.—The first part of the Eleventh Annual Tournament of the London Private Fire Brigades' Association was held on Saturday, September 25th, on the Parade Ground of the Royal Hospital Schools, Greenwich, when 25 brigades drawn from London and the provinces competed for the "Nestle" Challenge Cup for the Private Fire Brigade Championship of the United Kingdom, and for other trophies, including the "Dewar" Challenge Shield and the "Marshall" Challenge Cup for London Private Fire Brigades. In the above events the Robertson Electric Lamps, Ltd., Fire Brigade was successful in winning the Championship of the United Kingdom, and the "Dewar" Challenge Shield, the winning times constituting records for drills of this class. They also carried off First Prize in the four-men drill, First Prize in the five-men drill, and secured a substantial lead of 18 points towards the best aggregate for the "Marshall" Challenge Cup. The second part of the tournament will take place some time in November.

Educational Notes.—UNIVERSITY COLLEGE.—In connection with the opening of the Session in the University College Faculty of Engineering, a public introductory lecture will be given on Wednesday, October 6th, at 5 p.m., by Prof. J. A. Fleming on "Electrical Inventions and the Training of Electrical Engineers." The chair will be taken by Mr. W. M. Mordey, president of the Institution of Electrical Engineers. The special and post-graduate courses for engineers in practice and graduates in engineering for the first term will begin as follows:—"Railway Engineering," by Mr. H. Deans, Thursday, October 7th, at 5 p.m.; "Recent Methods and Instruments in Surveying," by Mr. M. T. Ormsby, Friday, October 15th, at 4 p.m.; "Electrical Design," by Mr. H. M. Hobart, Wednesday, October 27th, at 11 a.m.

Rifle Shooting.—Two very keenly-contested and interesting matches were fought by the Electricity and Tramways Departments of the Leyton U.D.C. on September 9th and 23rd. The first match was contested at the Electricity Works by teams of six on each side. Seven rounds were fired by each competitor at two ranges, 15 and 25 yards, with Bisley targets. The total scores were—Electricity Department, 281; Tramways Department, 214; the Electricity Department thus winning by 67. The return match was held at the Tramway Depôt, with teams of six on each side; ten rounds were fired by each competitor at three ranges, viz., 15, 25 and 35 yards, decimal targets being used. The rivalry was very keen, and the scoring very close. Total scores—Electricity Department, 1,016; Tramways Department, 993; the Electricity Department thus again winning, by 27. The hon. sec. of the Leyton Electricity Works Rifle Club will be pleased to arrange matches with other electricity works rifle clubs. Secretaries are requested to communicate with Mr. J. W. Gibbins, hon. sec., Electricity Works, Cathall Road, Leytonstone.

Amber-Tinted Spectacles for Arc Lamp Operators.—In the *Standard* of Tuesday last mention is made of Dr. Cook's discovery that goggles with amber-tinted glass were immensely superior to smoked or blue glasses in affording protection to the eyes from the blinding glare of the sunlit snows. In this connection, it strikes us as a singular fact that it is customary to use dense blue glasses for examining the electric arc, with the result that absolutely nothing but the arc and the glowing tips of the carbons can be distinguished through them, to the great inconvenience of the operator, who either dispenses with the glasses and takes the consequences, or is obliged continually to put them on and off. Blue glasses present little obstruction to the actinic rays of light, which in all probability are responsible for the excruciating pain resulting from exposure of the eyes to the arc light, and why they should be employed in these enlightened days it is impossible to understand.

Our Mr. Gatehouse, and other pupils of the late Robert Sabine—a scientist of no mean order, though he thought too little of his achievements to claim for them the credit that was his due—well remember how, at his suggestion, they wore amber-tinted glasses while experimenting with the Serrin, Duboscq and similar lamps in the days when arc lamps were regulated by clockwork, and each was fed by a single Gramme dynamo. With these glasses they were able to examine the arc with perfect immunity from after-effects, while the glasses presented no obstacle to the perception of the mechanism of the lamp itself, and therefore could be worn continuously without any inconvenience. Why use dense—almost opaque—blue glasses, when transparent amber affords equal protection without any drawbacks?

Institution Notes. — American Association of Car-Lighting Engineers. — The annual meeting of the Association of Car-Lighting Engineers is to be held from October 4th to 7th at the new La Salle Hotel, Chicago. The question of changing the scope of the Association will be brought up at this meeting. It is thought advisable to change the name to "Association of Railway Electrical Engineers," as most of the electrical engineers and chief electricians of the railroads have to do with general railway electrical work and are not confined to car-lighting work.

The Poplar Disinfectant Plant.—In view of the low cost of production of electrolytic disinfectant fluid and its efficiency, it has been decided to duplicate the Poplar plant at an estimated cost of £430. The new plant is to be as follows:—Four patent electrolysers, good for an output of 25 gallons of fluid at a strength of 4 grammes of chlorine per litre, and suited for a 240-volt circuit; one electric motor suited for a 240-volt circuit, arranged to hang vertically, and suited for driving two stirring machines; two stirring machines running on ball bearings, and fitted with suitable grooved pulleys; two ebonite stirring rods fitted to machines; one constant head flow regulating tank, suitably coated with preservative paint; one flow regulating cock, with vernier; one mixing tank of latest pattern; one switchboard equipped with D.P. main switch in cast-iron case, D.P. fuse in cast-iron case, one amperemeter, one voltmeter, provision for the Council's meter, and one series rheostat.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The electrical engineer of West Ham reports that in addition to Mr. H. H. Holmes, sales manager, Mr. K. A. Boshell, chief clerk in the general office, and four members of the sales department staff, have resigned their posts to take up positions under the Marylebone Council. The principal vacancies so caused are to be filled up as follows:—Mr. Farndon, at present assistant sales manager at £150 per annum and commission, is to be promoted to the position of sales manager at £250 per annum, rising to £300 at the end of 12 months' satisfactory service. Mr. Edgerton, at present meter superintendent at £150 per annum, is to be appointed assistant sales manager and meter superintendent at £200 per annum, rising to £250 after one year's satisfactory service. The clerical staff of the general office and sales department is to be amalgamated and re-arranged, and Mr. Johnson, at present in the accounts department at £125 per annum, is to be appointed chief clerk at £150 per annum, rising on satisfactory service by annual increments of £10 to £180 per annum.

Mr. J. Wright, shift engineer of Heston and Isleworth U.D.C. electricity works, has resigned, in order to take over a better appointment. Mr. J. Fletcher, jun., of the Nottingham and Derbyshire Power Co., has been appointed to the vacancy.

Mr. L. L. Horrell has been appointed by the Pretoria Town Council to the position of assistant electrical engineer at a salary of £500 per annum, with £60 extra for locomotive expenses.

Mr. Cuthbert W. Bentley, engineer and manager of the Wilmslow and Alderley Edge Electrical Supply Co., has been appointed manager to the Cromer Electricity Supply Co.

The Sydney (N.S.W.) City Council has, by 15 votes to 4, confirmed the appointment of Mr. Cochrane, of Ballarat, as chief assistant electrical engineer.

Mr. W. L. Trenery, of the staff of the Camborne and Redruth Urban Electric Supply Co., who is leaving for South Africa, has been presented by the staff and employés with a gold watch.

Tramway Officials.—Mr. J. H. Shepherd, manager of the Broughty Ferry Tramways, was, on the 23rd ult., presented by his staff with a suit case and an umbrella, on the occasion of his leaving the service of the company to take over the management of the Dunfermline and West of Fife Tramways. Mr. F. D. Scott, engineer of the company, made the presentation. Mr. Shepherd thanked the men for the gifts in suitable terms.

General.—The retirement is announced of Mr. E. J. Houghton, electrical engineer to the London, Brighton and South Coast Railway, after a service of 52 years. Mr. Houghton carries with him the good wishes of many friends, including the Electrical Review, which, during his long service, has been on several occasions indebted to him for courtesies shown. His chief assistant (and son) Mr. R. H. Houghton, B.Sc., A.M.I.C.E., A.M.I.E.E., has been appointed electrical engineer in his stead, with sole charge of telegraphs, electric lighting, power and electric traction.

Mr. W. H. Booth, artesian and steam engineer, has removed to Caxton House (West Block), Westminster, S.W.

The Glamorgan Education Committee have appointed Mr. R. E. Michael, of Tylorstown, a travelling lecturer in electrical engineering, at a salary of £150, increasing to £200.

The foremen and staff of Messrs. Crompton & Co., Ltd., Arc Works, Chelmsford, have presented a basket of cutlery to Mr. A. J. Beckett, a member of the staff, on his marriage.

Mr. W. B. Shaw, who has been the electrical engineer at the Hulton Colliery Co's collieries at Chequerbent, near Bolton, for several years, was presented by Mr. J. Tonge, general manager, on behalf of the officials and electrical staff, with a gold hunter watch, on Friday September 24th. The presentation took place at the Chequerbent Men's Club.

Mr. S. E. Bastow, of Messrs. Bruce Peebles & Co., Ltd., was entertained to dinner recently by a number of his friends in Edinburgh, preparatory to his leaving this country for a tour round the world on behalf of his firm. Mr. Bastow left by the *Tunisian* from Liverpool last week for Canada, and will proceed from there to Australia, New Zealand, and South Africa. He expects to be away for at least six months, and his many friends will wish him a safe and prosperous journey.

Owing to the lease of 2, Queen Anne's Gate, S.W., having changed hands, Messrs. Lacey, Sillar & Leigh have removed to Iddesleigh Mansions, Caxton Street, Westminster. Their telephone number and telegraphic address remain unaltered.

Mr. Sidney Sharp, M.I.Mech.E., M.I.E.E., notifies that in consequence of the acquisition of 34, Great George Street, S.W., by the Government, he has removed to 13, Victoria Street, S.W.

Mr. T. C. Martin has resigned the co-editorship of the *Electrical World*, of New York, in order to assume the position of General Secretary of the National Electric Light Association, of which he was one of the founders, and with which he has always been closely associated. The appointment was necessitated owing to the great growth of the Association membership. In entering upon his new work in the interests of the American central station industry, Mr. Martin carries with him the hearty good wishes of the London Electrical Review.

Obituary.—We regret to record the death of Mr. John Rance, jun., which occurred at Deal on September 16th. In his early days Mr. Rance was a successful student at the City and Guilds of London Institute, and afterwards a pupil at the Anglo-American Brush Electrical Works. He was employed by Messrs. Johnson & Phillips as engineer to put down the transmission of power plant at the Sheba Gold Mines, S.A., and a similar plant at the Raub Gold Mines, Malay States. His last appointment was with Messrs. Jessop & Co., Calcutta, and this he resigned in February last owing to a breakdown in his health. He returned home to recruit, but gradually got worse until a fortnight ago, when he passed away. Mr. Rance was an M.I.E.E., and was only 41 years of age.

CITY NOTES.

Willans & Robinson, Ltd.

The accounts for the half-year ended June 30th, 1909, show a loss of £3,501. Deducting this sum from the balance of £9,517 brought forward, leaves £6,015 available for distribution. The directors recommend the payment of a dividend at the rate of 3 per cent. per annum on the preference shares, which will absorb £4,999 19s., leaving a balance of £1,015 to be carried forward. There is no

profit available for payment of interest on, or redemption of, funding certificates, and it is not possible to pay any dividend on the ordinary shares. The regretable result shown for this half-year is due to the scarcity of work and to the low prices prevailing. The actual loss on the half-year's working at Rugby is £2,331. To this has to be added £1,170, the cost of keeping the Queen's Ferry Works in proper order and repair. The whole of the debenture interest is now charged against the Rugby account, and in considering the loss of £2,331 on that account it must be borne in mind that this result is arrived at after charging the Rugby profit and loss account with £4,824, the amount of the debenture interest for the half-year. The sum shown in the profit and loss account as written off against depreciation of premises, plant, machinery, patents, &c., viz., £4,203, is considerably less than in past half-years. The deficiency, however, in this provision is apparent and not real. A number of the working costs of the business, such as drawings, patterns, tools, and other appliances, which in past half-years have been charged against capital account and subsequently written off by depreciation, have in this half-year been charged direct against the profit and loss account. Although, therefore, the sum shown in the accounts as written off for depreciation this half-year is less than in the past, there are direct charges against profit and loss account to counterbalance this deficiency, and the actual provision made for keeping capital values on a sound basis is as ample as formerly. Debenture stock to the amount of £8,767 has been redeemed during the half-year out of the late fire insurance fund. This has been purchased at prices considerably below par. The difference between the face value and price paid, amounting to a sum of £1,761 and the balance of the fund itself, have been added to the main reserve fund, which, after deducting therefrom the amount paid on Mr. Robinson's retirement, stands at £62,630. The full preference dividend for the half-year might have been made up by drawing on the reserve fund. The directors, however, in view of the continued depression in business, do not feel justified in recommending such a course. The board are continuing their efforts for the disposal of Queen's Ferry Works, and although no sale has yet been effected, there is good reason to hope that negotiations now in progress will result favourably. A lawsuit, which has been hanging over the company in connection with one of their gas engine contracts has, since the books were closed, been settled by the payment of a sum of £15,000. This liability is provided for by the reserve fund, and the settlement of this case leaves the probable loss on the final disposal of Queen's Ferry as the only serious outstanding liability arising out of matters which were inquired into by the Advisory Committee in 1904. There is a considerable quantity of Diesel engine work in the shops at the present time; but the Diesel Co. have, so far, been able to place only a small proportion of the orders due under their agreement. It is hoped that, before long, there will be a revival in the demand for electrical generating machinery, and the company is now in an excellent position for securing a good proportion of the business when the revival takes place. Meanwhile, every effort is being made to push new developments such as turbo-pumps, water turbines, and condensing plant, so as to widen the base of the company's operations and make it less dependent on one class of manufacture. The first of the high-lift turbo-pumps has successfully passed its trials, and there are a number of these and of the water-turbines under construction in the shops. The directors do not for the present propose to make any addition to the board, or to fill up the vacant post of chairman. These matters have their earnest attention, and as soon as they are able to put forward proposals which will fully meet the best interests of the company, these will be laid before the shareholders.

Dick, Kerr & Co., Ltd.

The ordinary general meeting of the shareholders of the above company was held on Tuesday at the Cannon Street Hotel, Mr. John Kerr presiding.

The Chairman, in proposing the adoption of the report (see Elec. Rev., Sept. 24), said that there had been a very considerable diminution in the profits during the past 12 months' trading, as they only amounted to £28,168. Out of this had been paid debenture interest and trustees' fees, and in addition a sum had been reserved to provide for the premium payable in connection with the redemption of the present debenture stock. These items absorbed £12,693, leaving a balance of £15,475, and if they added the profits brought forward from last year, £81,567, they arrived at a total available for appropriation of £97,041. Turning to the balance-sheet, the ordinary and preference share capital was the same as in the previous year. They had, as usual, set aside £6,000 for redemption of debenture stock, and of this amount, £1,000 was redeemed prior to June 30th, and the trustees held an additional sum of £5,067, which they applied to redemption of debenture stock by drawings on July 31st. The total amount of debenture stock which had now been redeemed was about £34,000. There was very little difference in the liabilities to creditors; the reserves were exactly the same as in the previous year; the capital expenditure at the works had been reduced by a sum of £14,252; stocks in hand and work in progress, by about £7,500; debtors, exclusive of contract balances, by about £9,000; and the contracts due for work, stock of materials, &c., was increased by about £14,000; sundry investments had been reduced by about £43,000, and the cash balances were more or less the same as in the previous year. These figures called for no special comment. In the years 1907 and 1908 the directors in their reports stated that severe competition had prevailed in all departments, and they foreshadowed that this competition would become keener daily, and business more difficult to obtain. He regretted to say the year under review was the worst the company had experienced for many years, for not only had they had to contend with very severe home and foreign competition, but there had also been a serious diminution in the amount of work offered. Their tale was not different from that of most of the industrial companies in this country, for it was common knowledge that competition in their class of business had been even keener than in any of the other branches of manufacture. In nearly every department they had suffered a serious shrinkage, and although every effort had been put forth by the directors and the staff, they had not been able to secure profitable business, partly because there was not enough work to go round, and partly because of the difficulty in getting money for enterprises calling for their special manufactures. The directors foresaw this state of things some years ago, and therefore took the opportunity of dealing with the accounts in a very conservative spirit; so much so, that they built up reserves amounting to £216,000, and if they included the present year's carry forward the total reserves amounted to £279,000. In dealing with the accounts for the year under review they had adopted the same policy as they had always followed, *i.e.*, depreciated to the same extent—perhaps even a little more than in the previous year—and reserved against all manner of contingencies; so that although they showed a very diminished profit, everything had been done on the same scale as in previous years when they were making large profits. Their works in Preston and Scotland had been maintained in the highest state of efficiency, and all that was wanted was a revival of business. They heard that business in America and Germany was improving very rapidly, and it was reasonable to hope that if those countries continued to show progress we in this country should get some of "the crumbs which fall from the rich man's table." It was hopeless for them to expect much more than crumbs having regard to the industrial conditions under which they were working, and judging from past experience a revival in trade generally began in America and Germany before it reached us. He was not there to make a political speech, but he thought most of them would admit that this fact was worthy of investigation even by the members of the present Government. He regretted to say it was impossible for the directors to hold out any bright hopes for the current year. They were doing their best in the shareholders' interests, and they might rely that nothing would be left undone to improve matters, and should business take a turn for the better within the next few months, they were quite ready to take advantage of it. He thought it right, however, to add that they were for the moment living in hope only, and that whatever might happen in other trades, he did not see that in this particular branch of business there was any likelihood of any great improvement for the next few months. They were gradually extending their connection in foreign markets, and were hopeful that when competition became less keen they would be able to get better prices and make more profit. The reputation of their manufactures and work generally stood as high as it ever did, and even now, although prices were cut to nothing, they were still maintaining the same quality all through.

Mr. R. H. Prestwich seconded the motion, and the report was adopted.

Mr. J. B. Glenn, in moving a vote of thanks to the chairman and directors, remarked that when competition was keen it necessitated the directors working harder than ever, and he was sure that the board of Dick, Kerr & Co. must have worked very hard last year, otherwise the result would not have been so satisfactory as it was, although they would naturally have liked to have seen a bigger profit.

Mr. Barningham, in seconding the motion, which was agreed to, said that when they looked round at other electrical concerns, he thought they had reason to be perfectly satisfied with the year's working. They ought to be very thankful that the directors had been able to pay a 6 per cent. dividend on the ordinary shares.

The Chairman, in acknowledging the vote, said that all the directors had worked hard, and had been very ably assisted by the staff. They intended to continue those efforts, and looked forward to better times.

Calcutta Electric Supply Corporation, Ltd.—The directors have declared an interim dividend on the ordinary shares at the rate of 6¼ per cent. per annum, for the half-year ended June 30th last, payable on November 15th.

Babcock & Wilcox, Ltd.—The directors announce an interim dividend of 8 per cent. on the ordinary shares for the past half-year.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.—The directors have declared a dividend on the preference shares at the rate of 6 per cent. per annum for the six months ending 30th ult.

Lisbon Electric Tramways, Ltd.—The directors have declared an interim dividend of 2½ per cent., free of income-tax, on account of the current year.

Eastern Telegraph Co., Ltd.—A dividend at the rate of 3½ per cent. per annum, less income-tax, on the preference stock for the quarter to September 30th, and the second quarterly interim dividend of 1¼ per cent. on the ordinary stock, free of income-tax, are announced.

Continental.—Switzerland.—The balance-sheet of the Oerlikon Co., of Oerlikon, near Zurich, for the last financial year shows a net profit of £17,867; a dividend of 4 per cent. is being declared, the same as for the preceding 12 months.

Germany.—The Stettiner Electricitätswerke Gesellschaft, of Stettin, is declaring a dividend of 7 per cent. for the last financial year, the same as for the preceding 12 months.

MARKET QUOTATIONS.

Wednesday, September 29th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	28/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal)	per ton	£39	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (50 %)	„	£11	£1 dec.
a Copper Sulphate	„	£18 10	..
a Lead, Nitrate	„	£26 10	..
a „ White Sugar	„	£23 10	..
a „ Peroxide	„	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a „ Chlorate	per lb.	8½d.	..
a „ Perchlorate	„	8¾d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	„	£6 10	..
„ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70 %)	„	£10 15	..
a „ Chlorate	per lb.	3½d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a „ Cyanide (basis 100 %)	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£80	..
b „ Wire, in ton lots	„	£112	..
b „ Sheet, in ton lots	„	£120	..
p Babbitt's metal ingots	„	£50 to £136	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7⅛d.	..
c „ Tube (brazed)	„	7¼d.	¼d. dec.
c „ „ (solid drawn)	„	8¾d.	1¼d. inc.
c „ Wire, basis	„	6¾d.	..
c Copper Tubes (brazed)	„	8¾d.	..
c „ „ (solid drawn	„	8¾d.	..
g „ Bars (best selected)	per ton	£72	£1 inc.
g „ Sheet	„	£72	£1 inc.
g „ Rod	„	£73	£1 inc.
e „ (Electrolytic) Bars	„	£60 10	..
e „ „ Sheets	„	£77	..
e „ „ Rod	„	£65 10	..
e „ „ H.C. Wire	per lb.	7¾d.	.. ?
f Ebonite Rod	„	3/3	..
f „ Sheet	„	3/-	..
n German Silver Wire	„	1/6	..
h Gutta-percha, fine	„	5/6 to 6/6	..
h India-rubber, Para fine	„	9/1	8d. inc.
l Iron Pig (Cleveland warrants)	per ton	59/6	1/6 inc.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Ingot	„	£13 7 6 to £13 10	7/6 inc.
m Manganin Wire No. 28	per lb.	6/6	..
q Mercury	per bot.	£12 12 6	£4 5 inc.
d Mica (in original cases) small	per lb.	6d. to 1s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	1/- to 1/1½	..
p „ „ rolled bars & rods	„	1/1½ to 1/3	..
p „ „ rolled strip & sheet	„	1/2½ to 1/6	..
o Platinum	per oz.	105/-	variable.
e Silicium Bronze Wire	per lb.	9d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£137	£1 10 inc.
n „ Wire, Nos. 1 to 16	per lb.	1/9	..
p White Anti-friction Metals:—			
"White Ant" brand	per ton	£35 to £60	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£26 10	10/- inc.

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Prospectus.—*Sialang Rubber Estates, Ltd.*—This company, which is offering an issue of 100,000 shares of £1 each at par, will acquire, amalgamate and further develop as rubber-producing properties the Estates Sialang, Batoe Gingging and Tebing Tinggi, on the East Coast of Sumatra.

Johnson-Lundell Electric Traction Co.—The annual meeting of the shareholders of this company was held on Tuesday at the Cannon Street Hotel. A representative of the ELECTRICAL REVIEW, who attended to report the proceedings, was informed that the meeting was private, and a request for a copy of the directors' report was refused.

Grassington Electric Supply Co., Ltd.—Mr. J. S. Fielden presided at the statutory meeting held at Skipton on 23rd ult. He said that it was hoped that the company would be in a position to supply by the end of October.

STOCKS AND SHARES.

Tuesday Afternoon.

WITH money-rates tending to become a little harder, the Investment departments remain rather under a cloud. The prospect of a General Election has no attraction for the Stock Exchange, members lamenting that the chances at present are none too bright for the Tariff Reformers, whose advent to power would, it is supposed, lead to improvement in confidence and prices.

Amongst the Electrical departments the most animated section is that concerned with the Mexican Light and Power group. The Mexican Government has been moved to take up the cudgels on behalf of the Mexican Light and Power Company, and by official reassuring messages the price of the Common shares was run up 3 points, the 5 per cent. Gold bonds also improving. The 5 per cent. bonds of the Mexican Electric Light Company have recovered their decline of last week.

Mexico Trams are ½ lower. Sao Paulo Trams rose to 152½, and Rio Trams at 93½ kept steady. Canadian General Common is 124½ and the 7 per cent. Preference stock 121.

As regards the value of the championship by the Mexican Government of the Power Company, full weight must be allowed, of course, to the statements of the experts who have been consulted. There are many people, however, who have a great dislike to anything which looks like an attempt to bolster up either confidence or quotations. Nevertheless, times occur when denial of adverse rumours may be necessary, and the students of such matters have to determine for themselves whether it is justifiable and judicious.

The financial writers in the newspapers are making a good deal of "copy" out of the Willans & Robinson report, which is certainly a poor one. The prices of the shares and Debenture stock, however, have not moved. Manufacturing descriptions are very quiet generally, but British Aluminium shares are looking up again, and the Ordinary at 15s. show a nominal rise of 5s.

The principal gamble amongst industrials just now is in rubber shares, where the Stock Exchange vies with Mincing Lane—or *vice versa*—as to which shall be considered as the true market. Prices are very well maintained. Shrewd cynics point out that it pays well to hold up the price of rubber at a high figure what time the printing presses turn out share certificates at a rate so rapid as that to which we have been accustomed for many weeks past.

Railway stocks remain sunk in depression. Paragraphs have been appearing as to a new tube being constructed from London to the Crystal Palace, and Brighton Railway stock gave way on this rumour, the improbability of which being true is abundantly evident on the face of it. But railway stocks are hopelessly out of fashion, and any stick is good enough to whack a dead donkey.

Metropolitans fell a point, Districts remaining steady. The Central London and City and South London issues have not moved. Underground Electric Railway 4½ per cent. and Income bonds are both 1 lower.

The little excitement aroused over British Columbia Electric Railway stocks has subsided, but the Preferred stock gained another point. Anglo-Argentine Tramways 4 per cent. Debenture is a shade easier, while Calcutta Trams Ordinary shares and the Debenture stock show small advances. British Electric Traction Preference receded ⅛ to 2½, and the second Debenture stock drooped to 64.

All kinds of reports, mostly denied, has been current concerning the possibility of an important consolidation of American cable companies. The very centre of the rumours is the Mackay, and the Common shares have risen no less than 6, making 12½ points during a fortnight. New York is alone responsible for the movement, the business over here in the issues being of the most retail description. Submarine Cable Trust certificates are 1 up, and a similar rise lifted American Telephone and Telegraph capital stock to 148. Direct United States Cable shares are 2s. 6d. to the good, although Anglo-American Telegraph Deferred shrunk a little.

United River Plate Telephone shares have shot up, recovering the deduction lately made for the value of the rights. The new shares are quoted at a premium of 1½, and buyers had little opportunity for picking up any at a cheap rate. National Telephone varieties have not altered, and Marconi's at 16s. 3d. show no change.

Electricity Supply shares are quiet and mostly featureless. Kensingtons pursue their steady upward progress in which Notting Hills have joined this week. Perhaps the coming of the winter may direct attention to the market; it wants something badly enough to unveil its attractions and potentialities.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1905.	1906.	1907.	1908.	Closing Quotations Sept. 21st.	Closing Quotations Sept. 28th.	Business done week ended Sept. 28th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2⅞ — 3⅛	2⅞ — 3⅛	..	..	..	Nil.
186,700	Do. do. 5 % Debs., Nos. 1 to 1,350 Red.	100	5 %	5 %	5 %	5 %	93 — 96	93 — 96	..	..	..	5 4 2
$181,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7½ %	8 %	8 %	8 %	146 —148	147 —149	147½	..	+1	5 7 5
$68,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 58,001 to 78,000	$1000	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 1 8
558,460	Anglo-American Telegraph	Stock	3½%	3½%	3½%	£3 4s.	61½ — 63½	61½ — 63½	..	..	..	5 2 3
3,220,770	Do. do. 5 % Pref.	Stock	5 %	5 %	5 %	5 %	104 —105	104 —105	105	104½	..	5 14 3
3,220,770	Do. do. do. Deferred	Stock	1½	12½	1 %	8/-	22 — 2 2½	21⅞ — 22½	22 1/16	21 1/16	— ½	1 16 1
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8 — 8⅜	8 — 8⅜	..	..	..	4 14 1
2,431,350	Commercial Cable, Stlng. 500 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	90 — 92	90 — 92	91½	90½	..	4 7 0
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	8½ — 9½	8½ — 9½	..	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17½ — 18½	17½ — 18½	..	..	..	5 9 7
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3 — 3½	3 — 3½	..	..	..	5 14 8
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½ — 8⅝	8½ — 8⅝	..	..	..	5 15 11
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100½ —102½	101½ —102½	..	..	..	2 3 11
60,710	Direct United States Cable	20	4½%	4½%	4½%	4½%	13⅛ — 13⅝	13⅛ — 13⅝	13 1/16	13⅛	+ ⅛	7 4 8
43,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,300, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	129 —131	129 —132	131	129½	..	5 6 10
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	85 — 87	85 — 87	86¼	85½	..	4 0 6
1,396,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	104½ —106½	104 —106	105	..	— ½	3 15 6
800,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	11⅞ — 12⅛	11⅞ — 12⅛	12 1/16	11 15/16	..	5 14 3
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104	104 —104	..	..	..	3 16 11
200,000‡	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5½%	10½ — 10⅝	10½ — 10⅝	10⅝	10 17/32	..	5 7 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜ — 14½	13⅜ — 14½	..	..	..	4 4 3
150,000	Great Northern Telegraph, of Copenhagen	10	24%	20 %	20 %	18 %	26 — 27	26 — 27	26⅜	..	..	b 13 4
10,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	51½ — 53½	51½ — 53½	53½	..	..	6 1 6
$41,380,400	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	89 — 92	95 — 98	91⅝	90	+6	4 1 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	77 — 79	79 — 81	79⅛	78	+2	4 18 9
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	3/32 — 1/4	2/- — 7/32	16/-	..	..	N 1
72,680	Monte Video Telephone Co., Ltd. Ord.	1	5 %	6 %	6 %	6 %	3/4 — 7/8	3/4 — 7/8	..	..	..	6 17 2
86,492	Do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	7/8 — 1	7/8 — 1	..	..	..	5 14 3
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 — 107½	106 —107½	106⅝	106½	..	5 11 7
3,725,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	121 —123	121 —123	122½	121	..	4 17 2
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 10⅞	10½ — 10⅞	10⅝	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅛ — 10⅜	10⅜ — 10½	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 1/16 — 5 1/8	5 1/16 — 5⅛	..	..	..	4 7 3
2 000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 — 100	98½	..	..	3 10 0
1,983,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	7 %	8 %	8 %	1 15/32 — 1 17/32	1 13/32 — 1 17/32	..	..	..	5 5 9
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 29/32 — 1 31/32	1 29/32 — 1 31/32	..	..	..	4 15 3
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..	4 13 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 —102	100 —102	103	..	..	3 18 5
11,889‡	Reuter's	8	5 %	5 %	5 %	5 %	7⅜ — 8¼	7⅜ — 8¼	7⅜	..	..	4 17 7
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100½ —102⅜	100½ —102⅜	..	..	..	4 7 10
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	180 —183	181 —184	..	..	+1	4 9 7
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅜ — 6⅝	6 1/16 — 6 1/16	6 1/16	6⅛	+ 5/16	5 14 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000 ..	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 8 10
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	2½%	2½%	2½%	1⅜ — 1⅝	1⅜ — 1⅝	31/3	20/-	..	3 14 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	109 —102	100 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980.. ..	10	7 %	7 %	7 %	7 %	19½ — 19⅝	19⅜ — 19⅝	19⅝	19⅜	+ ⅛	5 0 10
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	104½	..	..	3 16 2
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	5 %	8 %	6 %	6 %	8¾ — 9	8⅞ — 9¼	8 15/16	8⅞	+ ⅛	6 9 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£3 6	15 %	8¼ — 9⅛	8¾ — 9⅛	..	..	+ ⅛	15 15 10
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101½ —103⅛	101½ —103⅛	..	..	..	4 16 7

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	5	..	..	..	..	4⅝ — 4⅞	4⅝ — 4⅞	95/7½	92/6	..	5 2 4
500,000	Do. 5 % 2nd Pref., 800,001 to 1,500,000	5	..	..	..	..	4½ — 4⅝	4½ — 4⅝	..	..	..	5 17 8
978,260	Do. 4 % Deb. Stock	..	..	..	..	4 %	92½—93½	92¼ — 93¼	92¾	92¼	— ¼	4 5 10
332,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
580,000	Babcock & Wilcox, 1 to 580,000	1	20 %	20 %	20 %	20 %	4⅛ — 4⅜	4⅛ — 4⅜	92/6	91/3	..	4 6 11
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	1/2 — 9/16	1/2 — 1	..	..	+ ½	35 0 0
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	15 1 4
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	3⅜ — 3¾	3⅜ — 3⅝	..	..	..	7 10 11
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	2¾ — 3⅛	2¾ — 3⅛	..	..	..	5 14 3
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	95 — 98	96 — 99	..	..	..	5 14 7
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	8 %	8 %	144 —149	144 —149	147½	146	..	5 7 5
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	5 %	6 %	117 —122	118 —123	121	..	+1	4 17 7
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	106 —110	106 —110	..	..	..	4 10 1
233,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
183,301	British Electric Traction	10	3 %	Nil	Nil	Nil	3/16 — 1/4	3/16 — 1/4	14/-	10/-	..	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	3 %	1¾%	2 — 2⅛	1⅞ — 2⅛	45/-	37/6	— ⅛	6 9 9
1,178,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	84 — 87	84 — 87	85	..	..	5 14 11
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	63 — 67	63 — 67	..	..	..	6 14 4
100,000	British Insulated and Helsby Cables	5	8 %	10 %	10 %	10 %	7⅛ — 7⅝	7⅛ — 7⅝	..	..	..	6 10 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅜ — 6½	6⅜ — 6½	..	..	..	4 11 8
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
204,940‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	89 — 94	89 — 94	..	..	..	4 15 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	Nil	7/16 — 7/16	7/16 — 7/16	..	..	..	Nil
1,0 6,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	38 — 42	38 — 42	..	..	..	9 10 6
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	3/16 — 1/4	3/16 — 1/4	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	2½%	Nil	Nil	Nil	0 — 1/4	0 — 1/4	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	6 %	Nil	Nil	Nil	0 — 1/4	0 — 1/4	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	41 — 46	41 — 46	..	..	..	9 15 8
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	27 — 31	27 — 31	..	..	..	14 10 2
187,610	Calcutta Trams, 1 to 187,610	5	8 %	8 %	6 %	4½%	4⅜ — 5⅛	4⅜ — 5⅛	5⅛	5 1/16	+ ⅛	4 3 9
45,804	Do. 5 % Cum. Pref., Nos. 1 to 29,880..	5	5 %	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	..	..	..	5 0 0
850,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	97 —100	98 —101	..	..	+1	4 8 8
85,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	15 %	10⅜ — 11⅛	10⅜ — 11⅛	10⅞	10⅜	..	6 7 8
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	6⅜ — 6¾	6⅜ — 6¾	..	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105 —107	105 —107	105½	..	..	4 4 1
491,328	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	3/16 — 7/16	3/16 — 7/16	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	6 %	8 %	12 %	12½%	2 — 2⅛	2 — 2⅛	41/3	..	..	5 17 8
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4 %	106 —109	105 —108	..	..	..	3 13 5
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	4 %	3 %	3½%	61 — 63	61 — 63	62	61½	..	5 3 2
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86	85	..	4 14 2
554,655	Do. do. Def. do.	Stock	4 %	4 %	2 %	2½%	43 — 45	43 — 45	44	..	..	5 11 1
1,4 0,000	City and South London Railway	Stock	1¾%	2½%	2½%	1¾%	31 — 32	31 — 32	31½	31½	..	4 18 9
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	5 %	5 %	5 %	⅜ — 1½	⅜ — 1½	..	..	..	13 6 8
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	6 %	5 %	5 %	90 — 93	90 — 93	..	..	..	5 7 6

* Unless otherwise stated, all shares are fully paid. † A period of nine months. From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Shares.	Dividends for the last four years. 1905.	1906.	1907.	1908.	Closing Quotations Sept. 21st.	Closing Quotations Sept. 28th.	Business done week ended Sept. 28th, 1909. Highest	Lowest	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1 — 1⅛	1 — 1⅛	21/9	21/3	..	8 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	4 14 1
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12⅝— 13⅜	12⅝— 13⅜	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½%	4½%	2½%	1⅜%	7/16— 7/16	7/16— 7/16	..	..	..	24 0 0
17,189	Do. "A" shares, 01—017,189	5	4½%	4½%	2½%	2⅜%	1 — 1⅛	1 — 1⅛	..	..	..	8 6 8
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	68 — 73	68 — 72	..	..	..	5 9 7
67,790	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	84 — 87	84 — 87	..	..	..	5 12 4
119,100	Electric Construction, 1 to 119,100	1	Nil	Nil	Nil	Nil	7/16— 1⅛	7/16— 1⅛	10/-	..	..	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	1	7 %	7 %	7 %	7 %	1⅛— 1⅛	1⅛— 1⅛	..	..	..	9 13 1
35,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7⅞ — 8½	7⅞ — 8½	8/10	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	85 — 88	85 — 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	¾	Nil	¾ — 1	¾ — 1	..	..	..	6 13 4
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ — 10⅝	10⅝ — 10⅝	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15 %	15%	15 %	12½ — 13½	12½ — 13½	..	..	..	5 12 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅝ — 5¾	5⅝ — 5¾	5 7/16	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	106	..	..	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works..	10	10%	10 %	10 %	10 %	14⅜ — 15½	14⅜ — 15½	..	..	..	6 13 4
97,500	Liverpool Overhead Railway, Ord.	10	Nil	Nil	¼	Nil	¾ — ¾	¾ — ¾	..	..	..	Nil
10,000	Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	4½ — 4¾	4½ — 5	..	..	+ ½	10 0 0
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	3 %	Nil	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
999,990	Do. do. 60,008 to 100,000	10	3 %	3 %	3 %	Nil	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	3⅜%	2½ — 2⅝	2½ — 2⅝	49/4½	..	..	18 12 8
1,321,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 70	67 — 70	68	..	..	5 14 4
5,782,062	Metropolitan Consolidated	100	2⅜%	1 ⅝%	⅝%	⅝%	39½ — 39¾	38⅛ — 38⅜	39½	38½	—1	1 5 9
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	2⅜%	65 —67	65 — 67	6⅝	6⅝	..	4 2 1
8,285,000	Do. District	100	Nil	Nil	Nil	Nil	16 — 16⅛	16 — 16⅛	16⅝	16	..	Nil
891,337	Metropolitan Electric Trams., Ord.	1	..	..	..	4⅛%	⅛ — ⅜	⅛ — ⅜	..	..	..	..
814,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..	6 3 1
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	94½ — 96½	94½ — 95½	95⅝	..	..	4 13 3
10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	..	126¾—129¼	125 —128	127½	125½	..	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	..	5 %	91 — 93	90 — 92	92	90	..	5 7 6
245,500	Potteries Electric Traction	1	4 %	4 %	4 %	Nil	⅛ — ¼	⅛ — ¼	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ — ¼	⅛ — ¼	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	86 — 89	86 — 89	..	..	..	5 1 2
87,850	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15 %	34½ — 36	34½ — 36	34½	..	..	5 0 0
140,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1900	100	4 %	4 %	4 %	4 %	100½ -102½	101 —103	..	..	+ ½	3 17 8
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	5 %	102¼ —103¼	102¼ —103¼	103	102⅜	—1	4 16 7
2,800,000	Do. do. 4½% Bonds	..	..	..	..	4½%	88 — 90	87 — 89	88⅜	..	..	5 1 2
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	86 — 88	85 — 87	86⅛	..	—1	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	6	Nil	Nil	10 %	Nil	⅛ — ¼	⅛ — ¼	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 126,001 to 141,666	1	Nil	..	6 %	6 %	2⅛ — 2½	2⅛ — 2½	58/9	..	..	1 18 5
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	78 — 82	78 — 82	..	..	..	4 17 7

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000		5½%	5½%	5½%	5½%	4⅞— 4⅞	4⅞— 4⅞	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10%	10 %	10 %	7½ — 7⅝	7½ — 7⅝	..	..	..	6 9 0
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8	7⅛ — 8	..	..	..	4 7 6
836,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 — 4½	4 — 4½	82/6	..	..	5 11 1
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4½ — 5	4½ — 5	91/3	..	..	4 10 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅜	3⅞ — 4⅜	..	..	..	5 2 10
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	3 19 3
49,486	Chelsea Electricity Supply, Ord.	5	6 %	4½%	4½%	4½%	3⅞— 4	3⅞— 4	72/6	..	..	5 12 6
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	10⅜ — 10⅞	10½ — 11	10⅝	..	+ ⅛	5 9 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ — 12⅝	11⅜ — 12⅝	12⅝	..	..	4 12 4
400,000‡	Do. 5% Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
50,000	County of Durham Electrical Power, Ord.	5	4 %	4 %	2 %	..	1⅛ — 2	1⅛ — 2	..	..	..	5 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	3 — 3½	3 — 3½	..	..	..	7 2 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	5 %	93½ — 95½	93½ — 95½	..	..	..	5 4 9
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	7⅞	7⅞	..	6 1 3
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅝ — 11⅛	10⅝ — 11⅛	10⅝	10⅝	..	5 7 10
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..	..	Nil
480,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	58 — 61	58 — 61	..	..	..	7 7 7
$8,160,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	..	5 %	84 — 86	91 — 94	84	..	+7	5 6 5
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅛ — 5	4⅛ — 5	..	..	..	6 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	9 %	9 %	8½%	8½%	7⅞ — 7⅞	7⅞ — 7⅞	7⅞	..	..	5 11 6
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	5 %	99 —101	99 —101	100	..	..	4 19 0
31,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8	6⅞ — 7⅛	7 — 7⅛	..	..	+ ⅛	5 4 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	4 %	2½%	3 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..	4 16 0
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..	5 17 1
882,855	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4½%	4 %	93 — 97	93 — 97	..	..	..	4 2 6
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	6½%	5 %	4 — 4¼	4 — 4⅛	86/10½	85/-	..	5 11 1
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝ — 5	4⅝ — 5	..	..	..	4 10 0
235,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
248,000‡	Do. 5% Mort. Deben. Stock Redeem.	Stock	5½%	5½%	3½%	3½%	83½ — 86½	83½ — 86½	..	..	..	4 0 11
$6,000,000	Mexican Electric Light Co.. 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	79 — 81	80 — 82	81⅝	79½	..	6 3 5
13,585,000	Do. Light and Powe Co Ltd., Common	$100	..	..	..	3½%	67 — 71	70 — 74	72½	68½	+3	4 14 7
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	7 %	102 —106	102 —106	103⅜	102½	..	6 12 1
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	5 %	83 — 85	83½ — 86½	85½	82	+ ½	5 17 0
260,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 4
130,491	Newcastle-on-Tyne, 1 to 197,500	5	8 %	8 %	8 %	8½%	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	2 14 0
197,500	Do. 5 % Pref., 1 to 197,500	5	5 %	5 %	5 %	5 %	4½ — 5½	4½ — 5½	..	..	..	4 16 3
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	..	99 — 101	99 —101	..	..	..	..
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	12 — 13	12½ — 13½	..	..	+ ½	5 6 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6 — 6⅛	6 — 6⅛	..	..	..	5 7 8
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 190,507	1	..	2½%	6 %	8 %	1⅛ — 1⅞	1⅛ — 1⅞	..	..	..	5 6 8
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	5 10 4
200,000	Do. do. 6% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	103 —106	103 —106	..	..	..	4 14 4
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	10 %	8⅝ — 9⅛	8⅝ — 9⅛	..	..	..	6 7 0
40,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	4 11 10
150,000‡	Do. do. 5½ % Deb. Stock Red.	100	5 %	5½%	5½%	5½%	84 — 88	84 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
85,000	South London Electric Supply, Ord.	4	4 %	3 %	4 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	2½%	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅛	1⅛ — 1⅛	21/10½	..	..	5 17 11
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	¾ — 1	¾ — 1	..	..	..	25 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛ — 1⅞	1⅛ — 1⅞	..	..	..	18 3 8
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	77 — 81	77 — 81	..	..	..	5 11 1
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	5 %	37/32 — 38/32	37/32 — 38/32	..	..	..	5 9 7
110,000	Westminster Electric Supply, Ord.	5	13 %	12 %	10 %	10 %	8½ — 9	8½ — 9	..	..	..	5 11 1
81,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	5 %	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 3 0

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. Interim Dividend.

SOME NOTES ON THE ERECTION OF POLES FOR OVERHEAD LINES.

By "WIGWAM."

To those inexperienced in the erection of poles and lines, the work may appear comparatively easy and so straightforward that mistakes would be exceptional; but there is a good deal to be learnt, even from the humble "ganger" on the subject, before the pole-line shows the mark of the workman rather than that of the novice.

The following are some points that should be useful to those who have to undertake such work for the first time, and they may also be useful to many who wish to improve some of their present methods.

In this country practically all the poles used are creosoted to preserve them against climatic conditions. This process of creosoting consists of injecting creosote oil into the fibres under pressure; the poles are placed in a long cylindrical tank which is filled with the oil and, after closing up all the doors, further oil is forced in by means of pumps so as to give a pressure of 10 lb. per sq. in. inside the tank. This pressure is maintained until the oil has found its way into the poles.

It will be easily understood that the oil, under pressure, will find its way into the weak places in the wood fibre, fill these readily and so preserve them whilst, where the timber is hard and seasoned, the oil may only partially penetrate. The fact that the oil has only partly got into these places proves that the wood is sound and does not require the preservative. If the pole has to be cut, as for the fixing of the arms, and the cut extends through the creosoted portion into the white wood, the oil will run into the opened portion and the wound thus becomes self-healing. Most of our readers will have observed workmen placing timber protection over the signal wires and points on the railways, and that, as the timber is cut up, the white interior is exposed, but after a day or two the oil has run into the exposed parts, and these have the same appearance as the rest of the timber, *i.e.*, the wound has healed up.

A similar process takes place with creosoted poles, and we need not be unduly alarmed if we find, on cutting into a pole, that some parts of it do not appear to have been thoroughly treated.

In countries where the poles are subject to the attention of insects, it is further advisable to char them from the butt up to about 2 ft. above the ground level; this is easily done by rolling them above a broad fire and smearing them with tar to make them burn. It is convenient also, whilst the pole is still on the ground, to fit it with the arms, cap, earth wire or any other fittings, and then to remove them except the earth wire during erection, so that they are easily replaced when the pole is in position. This is a far quicker and safer method than to dress the pole and attach the fittings after erection.

If the poles are heavy and a portable derrick can be used, this is the quickest way of planting them, but poles of average size and weight, such as are most commonly used, can be readily planted, as shown in fig. 1, with no other appliance than a couple of ladders and two short ropes. The writer has erected poles up to 40 ft. in length and about 7 in. in diameter at the top in this way. It will be seen from the sketch that the hole is long and narrow, and that as the pole is lifted at the top, it tends to slide itself into position. A stout flat piece of timber is placed, as shown at the front end, and the butt of the pole slides down this; if the ground is soft, flat boards may also be fixed at the sides to prevent their being broken in. These boards are, of course, removed when the pole is erect, and the earth is firmly rammed round the base. Poles are usually placed about 45 yards apart (*i.e.*, 40 to the mile) and $\frac{1}{4}$th of their total length in the ground, but, where the conditions are favourable, the spacing is frequently increased up to 60 yards. In public roads, or where the lines cross public roads, the Board of Trade conditions must be complied with, and the Post Office also places certain restrictions where its lines are crossed. Printed particulars as to height and guard wires can usually be obtained from the local post office engineer. On private land the spacing is usually governed by the weight of wire to be carried and the number of angles in the line, and also by the degree of exposure to storms and wind pressure, but, only in exceptional circumstances, is it necessary to have them closer than 40 yards.

Stays must be provided to support the pole where there is side pull, but if this is only slight, as where the line diverges a little from the straight, a stay may be avoided by giving the

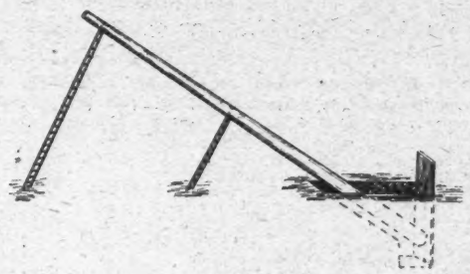


Fig. 1.

pole a slight "rake" in the opposite direction to that of the pull. The amount of "rake" required so that the pole may be perpendicular after completion can only be judged from experience, but a little practice soon teaches this. Stays should be of stranded galvanised-iron wire about $\frac{7}{16}$ or $\frac{7}{8}$ S.W.G., fitted with an adjustable swivel for altering the tension after erection. A piece of railway sleeper or a long stone makes a good anchorage. If an iron stay rod is used, the former is more convenient, since a hole is more conveniently made through it for the stay rod. If the stranded wire is used in the ground, the anchorage may be either the sleeper or stone or a short piece of railway metal; but it should not be of such a nature that it will rot in the ground; otherwise, as the anchorage rots away, the stay becomes useless.

The earth wire is, perhaps, one of the details most frequently neglected. It should be a stout galvanised-iron wire, about No. 8 S.W.G., securely stapled to the pole, and projecting well above the highest conductor, as shown in

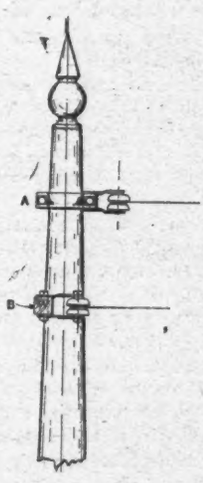


Fig. 2.

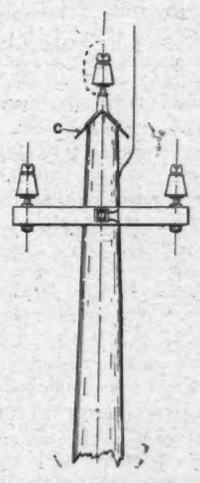


Fig. 3.

fig. 3. One frequently sees the earth wire cut off short at the cap, below the level of the top insulator, so that it is practically useless as a lightning conductor.

For light lines a wire guard, shown in dotted lines in fig. 3, is sometimes used, and is placed so that it will catch the line if the binding wire breaks. In this case the earth wire should be properly connected to the guard wire, which then forms the finial of the lightning conductor. The arm bolts and, if of metal, the arms also should be connected to the earth, as also must any guards or guard arms.

A galvanised iron roof or cap (*c*, fig. 3) is used to protect the top of the pole from the weather, and should be amply

large to more than cover the pole. The galvanised saddle bracket carrying the top insulator is fastened by four coach screws, or two coach screws and two clout nails driven through the pole roof. The whole of the iron work fittings should be galvanised to protect them from the weather. The arms are usually seasoned oak 2½ in. × 2½ in. for average size lines, and proportionately larger for heavy lines. The pole is notched to a depth of about 1 in., and the arm driven in tight, as shown at B, fig. 2, so that it will remain horizontal.

Fig. 2 also shows another point which is frequently overlooked, and this is, that the pull should be against the pole and not on the bolt as would be the case if the arm were on the right-hand side instead of on the left hand. This sketch also shows an arrangement for straining off the

Fig. 4.

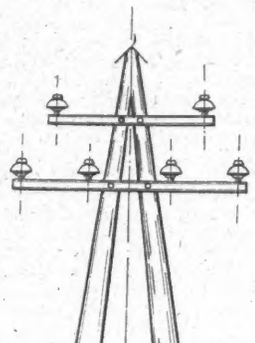


Fig. 5.

top wire by means of an iron clamp bent to fit the pole and double-ended if required to strain off in both directions. The finial shown on the same sketch add considerably to the general appearances, and for village or road lighting where appearances have to be considered, is well worth the slight extra cost. These finials can be bought at about 2s. to 2s. 6d. each, according to the size and quantity, and from this the cost of the pole roof may be deducted.

For this class of work, swan-necked insulators are frequently used instead of arms and bolts, and in some districts the supply companies are using them for power transmission at medium pressures (see fig. 4), and for both direct-current and three-phase transmission. Whilst it is generally to be recommended that for three-phase work the conductors should be equi-distant from each other, it is found in practice that spacing them at somewhat unequal distances does not make any appreciable difference to the losses under the conditions to be usually met with in this country. The use of swan-necked insulators may, however, be carried to extremes as anyone who has travelled on the French railways and observed the telegraph lines can testify; here one frequently sees 15 to 20 insulators with swan-necked bolts of various lengths and sizes carried by a short slender pole, and the arrangement falls far short of the solid construction to which we are accustomed in this country where arms carrying four, six, and even more wires are the rule.

For heavy construction, two poles joined together in the form of an "A" are to be recommended, and this arrangement has great stability, and will stand considerable side strain without staying; it is frequently used for high-tension lines where heavy guards are necessary. The poles are cut to fit each other at the top, and the arms form a further bracing, as shown in fig. 5. They also require bracing together at the butts, at any rate during erection.

In districts subject to lightning discharges, a galvanised barbed iron wire is often run on the apex of the poles, and forms a continuous earth wire as well as an effective lightning conductor running parallel to, but higher than, the transmission lines. It should be connected to the earth wire of each pole and earthed, by means of a copper plate about 2 ft. sq., at intervals of about ½ mile.

PROCEEDINGS OF INSTITUTIONS.

Hydro-Electric Power in Canada.

By Cecil B. Smith, M.Am.Soc.C.E.

(*Abstract of paper read before the* American Society of Civil Engineers, *September 1st*, 1909.)

(*Concluded from page* 908.)

Under the franchise conditions existing between this company and the Provincial Government, and having in view the water limitations now being reported on and recommended by the International Deep Waterways Commission, it would appear to be inevitable that this company will soon be forced to enter actively into exploitation of the Canadian market, in order to enable it to increase its output sales beyond the present, which amounts to about 40,000 H.P. from its own station, to which must be added some 5,000 H.P. obtained from the Electrical Development Co. and exported.

The combined output of the three stations of these allied companies, *i.e.*, the Niagara Falls Power Co. and the Canadian Niagara Power Co., is more than 500,000,000 KW.-hours per year, and the load factor is more than 70 per cent., owing to the large number of electrochemical customers.

Between 1902 and 1906 the Ontario Power Co. constructed, immediately below the cataract, a station which is equipped at present with six horizontal units, each of 10,000 or 12,000 E.H.P., generating three-phase, 25-cycle, 12,000-volt current, at 187½ R.P.M., under a net head of 178 ft. The turbines are of German design and manufacture. The water is brought to the station by an 18-ft. steel pipe, 6,500 ft. long, which is embedded in concrete just below the hydraulic grade line, and buried in Queen Victoria Park a few feet beneath the surface.

This company selected a favourable location for its entrance works and forebay, which are located at the head of the rapids and are completed for a capacity of 180,000 H.P., and, as far as ice troubles are concerned, it may confidently expect to give a continuous service.*

In several other features these works are interesting, particularly in respect of the methods of control. To handle successfully an 18-ft. column of water, 6,500 ft. long, moving at 15 ft. per sec., under ordinary commercial electrical conditions, was no mean task, but it is understood that, by means of a spiral overflow structure, this has been accomplished. The electrical control is centred in the transforming and distributing station, which is 600 ft. from the generating station and on the high bluff overlooking the cataract. At this point all the current from the generators to the high-tension lines is controlled. The transforming station is equipped with 18 single-phase, oil-insulated water-cooled transformers, each of 3,000 K.V.A., each bank being in a separate compartment. This company has created several allied companies which distribute 62,500-volt and 12,000-volt current in the United States and Canada. Its extreme eastern delivery is at Syracuse, N.Y., 161 miles distant, and it distributes current westward to St. Catharines, Welland and Port Colborne; but in view of the contract it has now entered into with the Hydro-Electric Power Commission of Ontario for the supply of from 25,000 to 100,000 H.P., at from $9.00 to $9.40 per H.P. per year for 12,000-volt continuous power, it appears evident that its sphere of influence in South-Western Ontario is in the near future to become very considerable, and the output of its station increased to at least 50,000 H.P. At present its maximum load is 25,000 H.P. in the United States and 5,000 H.P. in Canada, sales being at the rate of 110,000,000 KW.-hours per year.

This company's transmission lines are very extensive and varied in character, and comprise several hundred miles of double-circuit and single-circuit aluminium lines, chiefly mounted on steel towers carrying one circuit each. Some of the branch lines and 12,000-volt lines, however, are on timber A-frame towers or cedar poles; the various constructions have been carried out substantially and scientifically, but are subject to the criticism of transmitting at only 60,000 volts for distances up to 160 miles, whereas, at the present time, 80,000-volt transmissions are in use and 100,000-volt projects are under construction; however, it is true that the suspended insulator has not yet been fully developed to unquestioned satisfaction, and, at 100,000 volts, air emanations from conductors, line troubles, &c., are certain to be considerable.

In 1903 the Toronto and Niagara Power Co. was formed by parties interested in the Toronto Street Railway Co. and the Toronto Electric Light Co., and, after negotiations to buy electric current from other Niagara companies had failed, a lease was secured from the Provincial Government to build a generating station in Queen Victoria Park at Niagara Falls, at a site lying between those of the Canadian Niagara Power Co. and the Ontario Power Co., the works of both these companies being then under construction. The location chosen was notable in two particulars, the intake being almost wholly in the surging rapids above the cataract, while the tail-race tunnel was located so as to emerge beneath the cataract itself. The construction of these works proceeded from 1903 to 1907.

Preliminary to construction, it was most difficult to construct the coffer-dams and keep them watertight, and, together with the extensive overflow dam, &c., afterwards constructed, this made a heavy investment necessary. The wheel-pit is constructed for

* The author wrote before the troubles with ice last spring, when this station was flooded by an unprecedented rise in the water level.—Eds. E.R.

11 units, each of 8,000 KW., and four of these units are now installed. The operating head is about 140 ft., and the station is equipped with Francis double-runner turbines, constructed by United States manufacturers on Swiss models. In various items, however, these turbines differ from previous constructions. The draft-tubes are carried outward to twin parallel tail-race tunnels, and emerge from underneath so as to maintain the water seal. The penstocks are alternately right and left, in groups of two, thus economising in wheel-pit length. The supporting structures for the vertical main shafts of the units are concrete arches instead of steel girders. Altogether, these works give evidence of advance in the art of wheel-pit construction. The power house is a most ornate structure; indeed, this company has carried on all its operations with a lavish hand, and a resulting large investment. Its generating company is known as the Electrical Development Co., and the three-phase, 25-cycle, 12,000-volt current generated is delivered outside of Queen Victoria Park to a transformer station, whence the Toronto and Niagara Power Co. transmits it at 60,000 volts to Toronto, 80 miles distant (population 300,000), over a double-circuit steel-tower line. This line is carried across Hamilton Beach and Canal and the Welland Canal by pairs of very high and heavy towers; otherwise the transmission line passes through a level cultivated country without serious transmission difficulties, although including various spans across small valleys of more than 1,000 ft. each.

The transforming stations are built apparently with a great effort to attain safety, each single-phase transformer being in a separate compartment, and there is a very extensive concrete-cell construction for bus-bars, lightning-arrester compartments, &c. The Toronto terminal station also has an auxiliary water-tower for supplying water to transformers, in addition to the water service from the city mains. The current delivered at this station at 55,000 volts is stepped down to 11,000 volts, and is then carried by underground feeders to various sub-stations in the city, where it is transformed into 600-volt D.C. and various voltages A.C.; also, the frequency is changed from 25 to 60 cycles. Altogether, from 20,000 to 22,000 E.H.P. are used by the two subsidiary companies, in addition to sales at Niagara Falls to the Canadian Niagara Power Co. for export, as before mentioned, and there are also subsidiary companies formed to distribute eastward in the United States.

This brief description of the capacities of the various Niagara generating stations, amounting to 450,000 E.H.P. in Canada, when the stations described are fully equipped, and the fact that several other companies own charters and water rights, and are anxious to enter the field, if given opportunity and encouragement, at first would suggest that electrical energy can now be obtained in this favoured district at very low rates; and, comparing the rates offered with the cost to any given consumer to produce power or light by steam-driven prime movers, certainly the rates do improve these conditions somewhat, as is shown by the steady growth of electrically-operated industries in Hamilton, Ont. Moreover, from $20,000,000 to $25,000,000 have already been invested by these four companies in generating stations and transmission systems, which must find a return by the sale of the electrical output; but for the last ten years the people of South-Western Ontario have steadily asserted that, to create a great industrial area in that part of the province, still cheaper power ought to be and could be obtained.

Boards of Trade began to agitate in 1900, and in 1902 a committee was formed to take concrete action, which, by pressure on the Provincial Government, induced the passage of an Act in 1903, enabling two or more municipalities to appoint a Commission and, after investigation, to carry out, if desired, the construction of the necessary works at Niagara or elsewhere for generating, transmitting and distributing electrical energy.

This municipal Commission made a very exhaustive investigation, and reported in 1906 to the seven municipalities then represented in the movement, but there has been no specific outcome from this report.

In 1905 the Provincial Government, becoming more fully alive to the importance of this question, appointed a Government Commission to study and report on the hydraulic possibilities in the province, the industrial demand then existing for electrical energy, and the prime cost of generating and delivering the same to the various industrial centres and customers. The reports arising from the investigations were presented, in due course, to the Legislature during the session of 1905 6; but, although the facts elicited furnished a comprehensive idea of the industrial conditions then existing, and the cost of satisfying the same, and also, by comparison, set forth the rates offered by distributing companies, it has only been after a subsequent protracted struggle that definite results have been obtained and the evident will of the people carried out.

The vested interests immediately attacked the reports and the *bona fides* of those who drew them up, but the Provincial Government, recognising the demand made upon it, passed a very comprehensive Act, appointing a permanent Government Commission. In this commission were vested the rights of the Crown, and it was authorised to act in response to the demands of the municipalities and on their behalf.

This commission, after 2½ years' existence, has justified itself; and a group of sixteen municipalities has made a demand upon the Commission to secure electric power, to construct transmission lines from Niagara, to transform the electrical energy thus transmitted at the various sub-stations, to administer the construction, and to operate the works for a period of 30 years, over which period a sinking fund will be created out of the rates to repay the investments. The amount of power to be distributed immediately is approximately 30,000 E.H.P., but it is confidently expected that this will increase very rapidly to probably 100,000 E.H.P. in five years.

The various municipalities have voted the money necessary for local distribution, and the Government has recently contracted for the construction of 300 miles of transmission lines, and this work is to be followed immediately by the construction of the necessary sub-stations and local distributions.

This popular movement has yet to be justified by capable and honest administration, deficiency in which is the weakness of many municipal movements in America, and it is to be hoped that the ægis of the Government Commission will render the inherent merits of the project effective.

The large area of country to be covered, and the necessary anticipation of a still wider area as soon as the first installation has justified itself, have forced on the Government engineering staff a consideration of higher voltage, and, according to present plans, the ultimate voltage of transmission now being provided for is 100,000. This advanced practice, however, has been adopted by reason of the necessary provision for further extensions of the Hydro-Electric Commission's system to points still more distant from the generating station than London and St. Thomas (140 miles). The world will, doubtless, watch closely the results obtained in carrying out this huge municipal-provincial distribution of electrical energy.

The St. Lawrence River, between Lake Ontario and Montreal, may be considered as having its navigation interests paramount, and, although attempts have recently been made to obtain permission from the Canadian Government to devote the whole river to power development, it is not likely that such permission will ever be granted.

In the meantime, along the ship-canal system, many small installations have been permitted, but they are chiefly local in character and are devoted to operating mills and factories. They amount roughly to 10,000 H.P., and, in addition to this, hydro-electric stations having a capacity of about 5,000 H.P. supply the various near-by towns with light and power, and light the ship canals during the navigation season.

The whole river, if available, would be a great source of power, as it is capable of developing at low water 1,500,000 H.P. of electrical energy at the various rapids.

In the vicinity of Montreal (population 400,000), several interesting constructions have been made at various times by various companies, but finally all these interests have been merged into the Montreal Light, Heat and Power Company, which controls the situation at present, although a rival company has recently been organised to develop power on the abandoned Beauharnois Canal of the St. Lawrence system and transmit to Montreal and distribute in opposition to the Montreal Light, Heat and Power Company. The latest construction by the latter company is at Soulanges, on the Soulanges Canal of the St. Lawrence River, 27½ miles west of Montreal, where 40,000 cb. ft. per sec. are available under a head of 54 ft. The equipment now being installed consists of three units, each of 3,750 KW., which will generate three-phase, 60-cycle current at 4,000 volts. The transmission will be on one circuit at 44,000 to 40,000 volts, and the transformation will be made by banks of single-phase, water-cooled transformers having a rated capacity of 2,500 KW. per phase.

At present this company owns two water-power stations and four steam stations, the latter having a capacity of 9,000 H.P. The company also purchases 16,000 H.P. delivered in Montreal by the Shawinigan Water and Power Co.

The station at Lachine, on the St. Lawrence River, is an example of daring but mistaken construction, carried out 12 years ago, when the transmission problem had not been as fully worked out as at present. The works are really constructed as a part of the river, and, therefore, in operation they are subject to troubles from frazil in the head and tail-races; but after excessive expenditures, made for the purpose of creating quiet conditions above the power house and protecting the tail-race from back-water, the station can be reasonably depended on to give continuous winter service.

The dependable hydraulic head is only 14 ft., and the eight generators, each having a rated capacity of 750 KW., are operated by groups of six turbines each, driving jack shafts.

The current generated is three-phase, 60-cycle, at 4,400 volts, and is transmitted over 11 circuits at this voltage direct to Montreal (6½ miles), where it is stepped down to 2,400 volts for distribution. The station was designed for a capacity of 16,000 H.P., but it has never been equipped with machinery beyond 8,000 H.P.

At Chambly, on the Richelieu River, a branch of the St. Lawrence, 18 miles south-east of Montreal, the company owns a generating station which has also had a history interesting to engineers. The concrete dam, constructed to create a head of 34 ft., failed soon after completion, and the first year's operation was much disturbed by frazil; but a new dam has since replaced the faulty structure, and the station now operates normally.

The equipment consists of eight units, each of 1,800 KW., driven by four turbines per unit, the total generating capacity of the station being 20,000 E.H.P.; but the average load carried is 15,000 E.H.P. The current, which is 2,200-volt, two-phase, 66-cycle, is stepped up to 25,000 volts, three-phase, by 2,750-KW. single-phase air-blast transformers, and is delivered over four circuits to Montreal, where it is transformed into the city distribution systems.

The complexity of distribution at Montreal may be appreciated when it is noted that the current is of three different frequencies, namely, at 30 cycles from Shawinigan, at 60 from Lachine, and at 66 from Chambly, to which must be added the ordinary conversions to D.C., and to various distributing voltages, A.C.

The total distribution of power in the city from the various stations of the company varies from, say, 30,000 H.P. in the summer to as much as 53,000 H.P. at peak load in the winter, and this amount will be supplemented soon by delivery from the Soulanges station now under construction.

The St. Lawrence River Basin is traversed by many large tributaries, which will be discussed briefly in respect of such developments as have been carried out, but it may be stated briefly that, although many small towns and mining and milling centres have hydraulic and electric stations of modest proportions satisfying present needs, there yet remains opportunity for developing millions of horse-power on such rivers as the Ottawa and its tributaries, the St. Maurice, the Saugenay, the Trent, Spanish, Nepigon, &c., and projects innumerable of greater or less merit are being studied carefully by engineers and financiers with a view to meeting industrial needs as they arise, and creating new centres and industries to consume the available power.

The Kaministiqua Power Co. has constructed a generating station at Kakabeka Falls, on the Kaministiqua River, and transmits power to the City of Fort William (population 15,000), at the head of Lake Superior, where grain elevators, flour mills, foundries and municipal utilities consume some 6,000 or 7,000 H.P. at the present time.

The equipment consists of two 4,000-KW., three-phase, 60-cycle, 4,000-volt units, driven by German-built turbines, and the current is raised to 25,000 volts and transmitted 19 miles to Fort William.

In 1904 the Canadian Copper Co. (otherwise the International Nickel Co.) constructed a generating station on the Spanish River at Turbine, from which current is delivered to its mines and smelters at Copper Cliff, near Sudbury. Two 2,000-KW. units are installed, and a third is now under construction. The current as generated is three-phase, 25-cycle, at 2,400 volts, and is stepped up to 35,000 volts for transmission. It is carried 29 miles to Copper Cliff. The mines and smelters, it is understood, turn out more than one-half of the world's consumption of nickel.

The Mond Nickel Co. is installing a 1,500-H.P. hydro-electric station for similar purposes on the Vermilion River, and the current is to be transmitted 11 miles to the Victoria mines and smelters, 25 miles south-west of Sudbury.

The town of Orillia (population 6,000) has constructed a power station on the Severn River, and transmits some 1,600 to 1,800 H.P., at 22,000 volts, a distance of 20 miles.

The city of Ottawa (population 75,000) is in the midst of many developed and undeveloped water-powers, and the latter, in the event of the construction of the Georgian Bay Ship Canal, would become readily available at low investment costs. Within a radius of 75 miles of Ottawa City there can be developed on the Ottawa River and its main tributaries 500,000 H.P. at low water, which amount would be increased materially by the construction of the ship canal.

Near or in the city of Ottawa there are 10 hydraulic and hydro-electric developments operating under various heads, but chiefly on the Chaudière Falls at from 22 to 35 ft. These developments form the industrial centre of the city, and operate very extensive pulp and paper mills on both sides of the river. There are also cement mills, carbide furnaces, and other industries, and power for street railways, lighting, and general city use is also produced. About 35,000 H.P. is now developed, and, as many conflicting interests were contending for their respective shares of the flow of the river, it became evident that some improvement was imperative, so that an agreement to construct a proper dam at Chaudière Falls has been entered into and the work is in progress.

In the near future more power will be required, and it is proposed that the city itself develop the splendid powers quite near it on the Gatineau River, where a head of more than 80 ft. can be secured at a point within 8 miles of the city, and where 50,000 H.P. can be developed at one location. Considering the vast timber and mineral resources tributary to Ottawa, and its position as Capital of the Dominion, it may be considered certain that the availability of unlimited hydro-electric power assures the industrial future of the city.

The Ottawa is only one of many great rivers flowing into the St. Lawrence from the north between Montreal and the sea, and, as all these rivers rise in unbroken forests on the Laurentian highlands, and are well supplied with splendid storage facilities, they are all valuable sources of power. However, the sparse population has been a deterrent, and the only large works north of the St. Lawrence, and devoted to the generation of electrical energy for transmission purposes, is on the St. Maurice River at Shawinigan Falls, where the Shawinigan Water and Power Co. has created a large industrial town and also generates a large amount of power for transmission to Montreal, Sorel, Three Rivers, Thetford, &c., and will doubtless soon enter the field at Quebec in opposition to the present companies.

The hydraulic conditions at this place are most favourable, as the head-works consist of a natural lake, which prevents trouble from frazil in the winter. The drainage area is some 18,000 sq. miles, and a flow of 10,000 cb. ft. per second is considered the minimum. This, at a hydraulic head of 130 ft., provides more than 100,000 E.H.P. at all seasons. The works have been carried on partly for the generation of electrical energy and partly to operate local industries hydraulically. The products of these industries are pulp, paper, aluminium, carbide, &c.

The electric station has three 4,000-KW. and two 7,000-KW. units, generating two-phase 30 cycle current at 2,200 volts, and this is transformed to 50,000 volts by banks of 1,100-KW. and 2,200-KW. single-phase water-cooled transformers having a total capacity of 32,000 KW.

The transmission circuits are of aluminium cable on wooden poles. The Montreal service (85 miles) has been in operation for the past 10 or 12 years, and has given good satisfaction.

The delivery in Montreal is by two circuits, and amounts to 16,000 H.P.; besides which, the company serves the asbestos and other mineral districts on the south side of the St. Lawrence at Danville, Thetford, &c. The accomplishments of this company within the last 10 years have been considerable; indeed, its works form the basis of many large industries, and it can be confidently expected that the whole 100,000 H.P. available at this one water-power will be made use of in the near future.

In the vicinity of Quebec City (population 90,000), the installation on the Chaudière River, south of the St. Lawrence, has a hydraulic head of 114 ft., and is laid out for 6,000 H.P., but the equipment, thus far, is for not more than one-half this amount. The current is three-phase, 66-cycle, and is generated at 11,000 volts. It is transmitted to Levis and also to Quebec City by insulated cable laid on the bed of the river.

The Montmorency works, having a capacity of 4,000 H.P., have five units operating under a head of 220 ft., and generate two-phase current at 5,000 volts, which is transmitted direct over four circuits to the city sub-stations.

The Jacques Cartier works have 2,000 H.P. installed, and the current is transmitted 18 miles at 20,000 volts over two three-phase circuits to the city limits, where the company has a steam auxiliary station of about 2,000 H.P. to carry peak loads.

A careful consideration of the electrical data contained herein will indicate the trend of activity in Canada in hydro-electric investments and the reasons therefor. In general, it may be said that on the Atlantic Coast and over the western and central portions of the great plains very little benefit is to be derived from such constructions, but over all the Provinces of New Brunswick, Quebec, Ontario, Eastern Manitoba, Western Alberta and British Columbia the continued construction of additional hydro-electric stations and the distribution of electric current to the practical limits of transmission may be confidently predicted. The resources of Canada in minerals, timber and agriculture are so varied and so immense that the growth of industry as a legitimate outcome of the development of these resources, and the corresponding increase in population, may be looked on as a foregone conclusion, and it is as certain that, in this industrial growth, low-priced power will form a large factor.

At present the hydro-electric developments serve to a greater or less extent such industrial centres as Montreal, Quebec, Ottawa, Peterborough, Toronto, Hamilton, Winnipeg, and Vancouver, besides a great number of smaller ones; but only a beginning has been made. Probably the 500,000 H.P. now hydraulically developed would include only stations of 1,000 H.P. or more, and there are literally many millions of horse-power available for development within easy reach of the present population; but, apart from the increased industrial demand, there are specific demands of great importance. Already, as noted, several mining interests are served by hydro-electric power, and with the growth of mining investments the importance of such service will increase. Then again, pulp and paper (with the depletion of United States supplies) will become a much more important industry than at present, and consequently much hydraulic and electric power for 24-hour service will be thus consumed.

Particular attention is directed toward the enormous opportunities for electrochemical industry. At Niagara Falls, N.Y., a large group of such industries is now well established, and in Canada a modest beginning has been made at Shawinigan, Ottawa, and Niagara Falls, Ontario; but Canada has in its great rivers sources of power as cheap as any in the world, except that the labour item may increase slightly the investment per horse-power beyond that of a similar construction in Europe. The whole question rests on transportation and markets; the latter, artificially restricted by the United States tariff, must seek an outlet in Great Britain, and as it is well demonstrated that $10 per H.P.-year, continuous power, at the low-tension switchboards, is a remunerative price for large installations, and will cover all fixed charges, depreciation and attendance, there would appear to be a good field for investment.

The financial condition in Canada at present as regards hydro-electric enterprises is worth considering. Some 10 or 15 years ago many of the brighter minds in the country seized the idea that, by securing valuable long-term franchises on the one hand for electrical service, and on the other for water privileges on near-by rivers, a splendid opportunity existed for profitable exploiting.

The net result at present is that, in almost all the large towns and cities, these services are administered by companies whose charges for power and light are only regulated by two things: either the exigency of the occasion, or the cost of a similar service produced by the customer from coal usually imported from the United States; and as a good quality, run-of mine, bituminous coal costs from $3.50 to $4.00 per ton in Ontario and Quebec and $6.50 per ton in Manitoba, it is evident that such competition is harmless, and the electrical companies were and are able to do business at very profitable rates.

In recent years, however, the municipalities have become active, and several smaller towns and cities have constructed municipal hydro-electric stations. The movement is very active at present in the Province of Ontario, and to a less extent in other provinces.

The struggle is bound to be prolonged and bitter; indeed, much bad feeling and resort to disreputable tactics have already been exhibited. Municipal and provincial credit has been attacked in the London market, and all the influence which heavy vested interests can exert is and will be directed against further municipal action.

The ultimate result is evident; the public mind will become more and more inflamed by the obstruction of the electrical companies, and, undoubtedly, in the end, the municipalities will carry out the expressed wish of the majority; but in the meantime public credit is unsettled, the manufacturers are playing a waiting game, and no one is benefited, because the expansion of the market, with consequent advantage to everyone, including the electrical manufacturing companies, has not taken place.

It would appear advisable to consider the appointment of a Public Service Commission by the Dominion Government to regulate the rates which may be charged by companies already in operation, so as to secure that benefit to the public which the presence of abundant water power warrants, because it is not probable that, at the most, more than a majority of the industrial centres will be served municipally, and, judging by the results obtained by the Dominion Railway Commission, much satisfaction might be obtained and the public mind be set at rest, if a rate-regulating commission for electric utilities, with wide powers of action, were appointed.

Concurrently with the distribution of electric power for utilisation in cities, &c., it is to be anticipated that very large constructions will be undertaken in the near future to furnish power for the operation of railways over heavy grades where coal is expensive or traffic dense, and that at the same time the natural resources of the country will develop to an increasing extent, and that in mining work, pulp and paper manufacture, electric smelting, and general electrochemical service will be found the most attractive fields for the enormous and not fully appreciated sources of cheap and widely-distributed power which is now wasting in so many districts of Canada.

THE AUDIT OF THE ACCOUNTS OF TRAMWAY UNDERTAKINGS AND TRAMWAY FINANCE COMPANIES.

By "ACCOUNTANT."

(*Concluded from page* 516.)

Sometimes a tramway company may own a few investments, though somewhat nominal. Verification is effected in the case of registered securities by the production of the certificates in the case of bearer securities, by the production of share warrants to bearer or any other form of bearer certificate, and in the case of inscribed stock a note or certificate from the bank or house in whose books the stock is inscribed will be available.

The investments should be shown fully and conspicuously in the balance-sheet, and they are generally exhibited at cost. Market value is not of much importance, owing to the manipulation and devices of bulls and bears and frenzied quotations, though it is an excellent custom to value investments at market price (when they have a quotation) or cost, whichever happens to be the lower.

Premiums paid upon the leasing of property or sums paid for leasehold property as well as expenditure therein incidental to acquisition and consequent improvements, are sometimes incorporated in the balance-sheet with other expenditure covering quite a miscellaneous description of items. Such expenditure should be disintegrated, and provision made therefor, as well as for any necessary dilapidations by a leasehold policy of insurance, or any other form of redemption which meets the circumstances.

It is also necessary in some instances to make provision in respect of freehold property, but this can only be determined by the precise circumstances. When operating companies are constructing additional lines and works, and do not desire to raise further capital by way of issue of shares, or to incur, or increase, debenture debt, it is not an infrequent experience for them to be denuded occasionally of working capital, and it is upon the occurrence of such events that we may anticipate outstanding loans in the balance-sheet with the concomitant appearance of interest thereon in the profit and loss account.

On occasions in the past some companies have charged to capital interest on temporary loans and proportion of debenture interest on unproductive outlay, a proceeding which generally points to dire circumstances on revenue account. The Companies' Consolidation Act provides that where any shares of a company are issued for the purpose of raising money to defray the expenses of the construction of any works or buildings, or the provision of any plant which cannot be made profitable for a lengthened period, the company may pay interest on so much of such share capital as is for the time being paid up for the period and subject to the following conditions and restrictions, and may charge the same to capital as part of the cost of construction of the work, building or plant.

No such payment is to be made, however, unless the same is authorised by the company's articles of association, or by special resolution of the company, nor without the previous sanction of the Board of Trade. The payment may be made for only such period as may be determined by the Board of Trade, whilst the rate of interest is not to exceed 4 per cent., or such lower rate as may, for the time being, be prescribed by Order in Council. The payment of the interest will not operate as a reduction of the amount paid up on the shares in respect of which it is paid, and the account of the company must show the capital on which, and the rate at which, interest has been paid out of capital during the period to which the accounts relate.

It may be noted that the Companies' Clauses Consolidation Act, 1908, provides that the total amount of the sums paid by way of commission in respect of any shares or debentures or allowed by way of discount in respect of any debentures, is to be stated in the summary made under Sec. 26 of the Companies' Act, 1862, next after the payment of the commission or the allowance of the discount, and the total amount thereof, or so much thereof as has not been written off, shall be stated in every balance-sheet until the whole amount has been written off.

There are, of course, combined undertakings—that is, a company possessing both a tramway order and an electric lighting order. The Electric Lighting Acts provide that distinct accounts must be kept of each lighting order, which are rendered to the auditor on behalf of the Board of Trade. The lighting accounts are therefore kept separately from those of the tramway undertaking, a tariff or charge being made by the electric lighting section to the tramway section for the current supplied.

The basis of calculation in the operating costs of a tramway undertaking is the car-mile, it being the usual practice to prepare the cost statement every four weeks. The detailed information for this is readily obtained from such sources as the salaries and wages allocations, and the allocated stores issued, an estimated sum for head office and general expenses being included therein. The cost and traffic experiences are frequently exhibited in the form of a graph; but in a tramway undertaking the auditor is not concerned with costs except as a matter of personal or general interest.

The object of a Tramway Finance Co. is to finance approved existing undertakings and propositions, and thus acquire controlling power therein, and also to promote subsidiary companies. In short, their memoranda enable them to do almost anything electrical—tramways, lighting, power, and manufacturing. There are usually numerous agreements between the Finance Co. and its subsidiaries which require considerable attention on the part of the auditor.

A Tramway Finance Co., the financial year of which generally terminates some three to six months subsequently to that of its subsidiary companies, derives its income from, amongst other things, the following:—Interest on debentures; dividends on shares; interest on loans; underwriting and over-riding commissions; sales of securities; services rendered to subsidiary companies; profit on shares and debentures underwritten; rents, transfer fees, &c.; the postings being checked and the entries vouched in the ordinary way. Interest on loans to subsidiary companies is at times a fruitful source of income to a Tramway Finance Co. At other times it comes about that the subsidiaries have to lend to the Finance Co. In the former case they are loans, and in the latter case they are sometimes called deposits.

Let us suppose, with the object of providing a cursory sketch of a single phase of one type of the transactions of such companies that the Financial Co. X obtains an order for the construction of tramways in the town of Y. The work of construction may be done by either administration or contract, and if by contract, a proportion of the profit earned by the contractor may be provided for in the contract with him. The whole of the cost of construction, including that of the promotion of the order, legal and all other expenses and outlay in connection therewith, are kept quite distinct, and with possibly a profit thereon charged to the Y tramways. In due course a company is formed, called the Y Electric Traction Co., Ltd., and at a propitious time a public issue may be made. The Financial Co. thus controls the Tramways Co., appoints the secretary and staff and nominee directors, who may be paid either a salary or directors' fees—that is to say, they may either receive a salary from the Financial Co. (to whom, in which case, the fees are paid), and if not a salary, they may receive the fees from the Tramway Co. direct.

Some of the persons appointed, having been qualified by the Finance Co., are consequently removable at will; besides, there is little or no independent administration. The policy of the subsidiary is that dictated by the Finance Co., and it is well to note this significant feature.

The amount of the share capital depends primarily, *inter alia*, upon the original capital cost, otherwise the bill of the financial company, and the denomination of the shares upon varying circumstances. The denomination, however, should not exceed £1, and prior charges—such as the result of debentures and preferential shares—should be avoided whenever possible. A preference share is like a perpetual loan without security, and a 4 or 5 per cent. return on a tramway ordinary is not for the class of share and nature of the undertaking by any means a tempting inducement to the investor.

The subsidiary is formed, therefore, primarily for the purpose of contributing its quota to the dividends of the financial company. The purchase price may be payable as to so much in cash and so much in shares, whilst a substantial sum may be left upon loan at interest with an option to convert into debentures or shares, and so on. The determination of the mode of payment depends, however, upon a variety of circumstances, including the existing or prospective profit-earning capacity of the company, probable success or otherwise of public issue, and other factors of the particular situation.

In due time other companies are promoted, and, of course, they are all for the benefit of the electrical industry, whilst, as already pointed out, they are for the most part created for the purpose of founding primarily the revenue required by the finance company for the carrying on of its undertaking and the payment of interest and dividends on its debentures and shares.

The ordinary shares, at any rate of tramway companies controlled by a trust, are better avoided by the investor. The large blocks of subsidiary shares owned by a tramway finance company are to a large extent unsaleable, which is due to low yields, control by a trust which the public do not like, while many of them may not be quoted on the Stock Exchange, and there is not a free market and consequently little or no speculation.

In course of time a tramway finance company is condescending

enough to be willing to dispose of many of its acquired and low yield shares, the idea being to get rid of them and only retain a sufficient monetary interest in the subsidiary to ensure the maintenance of paramount control. The Tramway Finance Co. only sells its "refuse," so to speak, and frequently cloaks its identity in the offer for sale of large blocks. It, of course, only parts with its better paper in times of financial stress. Other finance companies have predilections for high interest bearing securities, the presumption being that the larger income enables an insurance fund to be created against potential loss of capital; but there are few high dividend or high interest-bearing securities in the tramway world. Sometimes the ordinaries are divided into preferred and deferred. Tramway deferreds are not infrequently the result of sops—like an article thrown in with a parcel of weak tea; a device to assist in the acquisition of a controlling interest.

When a tramway finance company is promoting and constructing, it, of course, requires capital, and profits, paper or otherwise, so that it may pay as high a dividend as possible, in order to attract or command capital issue premiums. A 9 or 10 per cent. can only be accomplished with the aid of precarious promotion profits, and when the time comes that they are not available or unrealisable, we experience the passing of dividends and huge depreciation in capital values.

Care should be taken to see that preference dividends are not paid what is commonly called "free of income-tax," it being *ultra vires*, except where authorised by the articles.

It is not unusual to take credit in the profit and loss account for unrealised paper profits, which means a drain upon working capital, and involves the risk of paying or distributing that which may never be partially or wholly received in cash, and which may eventuate in a loss which would have to come into profit and loss in future years. Credit for such paper profits should be noted on the accounts, or find expression in the auditors' certificate.

It will be remembered that in the case of the London Globe Finance Corporation, Ltd., which, by the way, was not a tramway finance company, the inflation of profits was effected by taking credit at par for shares received for properties transferred or sold when the cost of the property disposed of was considerably less, which may be exemplified in the following manner:—The X Finance Co. has a property upon which it has incurred an expenditure of, say, £10,000, and sells it to a subsidiary Y for £60,000, payable as to £5,000 in cash, and £55,000 in £1 fully-paid shares.

The proper way of stating the account is as follows:—

PROPERTY ACCOUNT.

Sundries ...	£10,000	Cash		£5,000
		55,000 shares of £1 each in Y., Ltd. (fully paid)		5,000
	£10,000			£10,000

55,000 shares of £1 each (fully paid) in Y., Ltd.

Property account £5,000

Here the shares stand in the books at cost; but if they are brought in at par there will be a paper profit of £50,000. Of course there is no realised profit, and until the shares are sold there has occurred only an exchange of assets. When any of the shares are sold at a price in excess of £5,000 the excess is a cash profit and one to be taken to the credit of profit and loss account.

Of no little importance is the duty of agreeing the debit and credit balances of the accounts of the subsidiary companies in the books of the finance company with the credit and debit balances of the finance company in the books of the subsidiary companies.

The principal asset in the balance-sheet of a tramway finance company is that of investments, and some of the points to which the auditor must give due prominence after the performance of the usual verification are:—

1. Basis of valuation.
2. Value and nominal amount, together with book values of securities at middle market prices—those quoted on the London and Provincial Stock Exchanges.
3. Expression of opinion, if any, as to market value of remaining securities, together with nominal amount.
4. Yield of nominal amount of securities and book values.
5. Nominal amount and book values of securities upon which there may be no return.
6. Uncalled liabilities.

Interesting problems will arise when the local authorities exercise their power of purchase, or when it is agreed for the Tramway Co. to sell its undertaking to the municipality.

There are many other important matters in the audit of the accounts of tramway and tramway finance companies, which have not been overlooked, but which have been passed over for the present owing to considerations of space.

Condensing Plant Contracts. — The MIRRLEES WATSON CO., LTD., have recently secured the following contracts:—Low level counter-current jet condensing plants per D. Selby Bigge and Co., consulting engineers, for Niddrie & Benhar Coal Co., Ltd.; Fife Coal Co., Ltd., Mary pit; Fife Coal Co., Ltd., Kinglassie pit; also surface condensing plant, for Aktiebolaget de Lavals Angturbin, Stockholm; barometric condensing plant, for Okura and Co., for Formosa, third repeat; and two sets of large three-throw air pumps for Henry Tate & Sons, Ltd., Silvertown, E.

THE USE OF ELECTRICITY IN AGRICULTURE.

In the year 1903 a number of German agriculturists formed a syndicate to establish electric power stations. In order to produce electrical energy at the lowest possible price, they endeavoured to utilise the water-powers in their immediate neighbourhood. Three large stations have been erected by the Allgemeine Elektricitäts-Gesellschaft: the Vangerow-Lottin and Bartin-Besswitz in Pomerania, and the Birnbaum-Meseritz-Schwerin in the Province of Posen.

The Vangerow-Lottin station has a water-power plant of 300 H.P., and steam plant of about 180 H.P. as a reserve. This station supplies 61 agricultural undertakings and five townships, together with 41,200 acres of arable land. The network of connecting wires is 137 kilometres in length, supplying an area of 270 sq. kilometres. There are 102 consumers, with 150 motors, equal to 1,115 H.P., and about 5,000 incandescent lamps. During last year about 440,000 units were supplied at an average price for energy of 12 pfg. (1½d) for power, and 27 pfg. (about 3½d.) for light per unit.

The second station, Bartin-Besswitz, which commenced operations last year, started with a transmission line of 180 kilometres, but 40 kilometres have been added, and this station now supplies 170,000 acres, of which 80,000 are ploughed land. There are 180 motors and about 5,000 incandescent lamps, representing together approximately 1,300 KW. The price of energy for lighting is 25 pfg.; for power there is a sliding scale of 11 to 15 pfg. Each member of the syndicate has to guarantee a minimum consumption of 5 KW.-hours per acre of arable land. An estate of 2,000 acres of ploughed land must, accordingly, consume 10,000 KW.-hours per annum.

The Birnbaum-Meseritz-Schwerin station has also begun operations, and already supplies 10 estates and 14 villages. After the completion of the works there will be about 162,000 acres of arable land and five townships, the length of cable being 316 km. Judging by the short time that the present stations have been erected, it will not be long before the country will be overspread with wires emanating from the same source of power. Three-phase overhead wires conduct the power for miles through field and forest, over meadows and rivers, to the consumers. Guard nets protect men and animals from broken wires; lightning conductors are also provided to protect the network from damage caused by atmospheric disturbances. Transformers convert the high-voltage current to a lower pressure such as is required for use on estates and in villages.

The transformers are generally housed in a small building; for field work, however, where the power is required in various places, portable transformors are used. By means of a flexible connection the primary of the transformer can be joined to the overhead wires at any desired point, whilst the secondary is connected to the motor. Thus the agriculturist is in a position to make use of the power in any portion of his land.

There is a great future in Germany for the use of electricity in agriculture on large estates. The question of the transport of goods on the property itself, as well as communication with the nearest railway station, is also naturally of great importance. In consequence of the possibility of obtaining cheap electric current from these central stations, the use of the electric locomotive becomes practicable.

A notable contract of this kind was carried out in the year 1905 by the A.E.G. on the Barfeld Estate, in Neumark. The estate had already for 10 years a branch line to the Ringenwald State Railway station, with a gauge of 600 mm., working on the Spalding system, with rails weighing 6·5 kg. per metre. The introduction of electricity required no alteration in the gauge; the only thing that had to be taken into account was the construction of the locomotives. The work is effected by means of two electric locomotives each of about 58 H.P., running at a speed of 25 km. per hour. The weight of the engine amounts to about 6,000 kg. In consequence of the distribution of this weight over eight wheels the wheel pressure does not exceed that of the existing cars. The locomotives can easily draw weights of about 50 tons on inclines of 1 : 40. For the last three and a half years this work has been carried on, with the best results. Formerly it required 60 horses to do the work which is now done by these two locomotives. The track was originally designed for an annual traffic of 160,000 cwt.; after three years' working it was carrying 450,000 cwt. per annum.

It is hoped that the use of electric field railways will be more widely extended, and that agriculturists will not be afraid of spending their capital on the work, which will amply repay them.

Another interesting contract carried out by the A.E.G. is the drainage of the newly reclaimed delta of the Memel over an extent of about 70,000 acres, which was undertaken in 1896. Six "scoop wheels" of 8 m. diameter are driven by electric motors, which are switched on or off from a central station, requiring no attention.

A similar plant of ten electrically-driven centrifugal pumps was installed in the year 1899 at the mouth of the Maas, in Holland. The motors are automatically controlled by floats. As soon as the surface of the water reaches a certain level, the motors are disconnected and the pumping is stopped.

The foregoing notes are derived from a lecture delivered by Chief Engineer Lewin to the A.E.G. staff, of which an abstract appeared in the *A.E.G. Zeitung* recently.

MUNICIPAL TRAMWAYS ASSOCIATION.

The eighth annual conference of the above Association held last week in London was in every way a success. It was attended by representatives of practically every municipal tramway undertaking in the country, the Council Chamber at the County Hall being well filled both on Wednesday and Thursday. Reference was made in our last issue to the interesting address in which Sir Melvill Beachcroft, the chairman of the London County Council, welcomed the delegates, and also to the address which Mr. A. L. C. Fell, the chief officer of tramways to the London County Council, delivered, as President of the Association. Following these, a paper was read by Dr. A. W. Chapman, the vice-chairman of the Manchester Corporation Tramways Committee, on "The Medical Examination of Tramway Employés." As the paper is referred to on another page, it is sufficient to say that the writer urged the necessity of a thorough independent medical examination of each employé, both on engagement and at stated intervals thereafter. This was demanded, in the writer's opinion, on the grounds of public safety, and of the protection of the undertaking from excessive claims under the Workmen's Compensation Act.

After luncheon, at the Trocadero Restaurant, at the invitation of the Chairman of the London County Council, the conference proceeded to discuss Dr. Chapman's paper. The first speaker was Mr. Nance, of Belfast, who stated that he looked at the matter from a utilitarian point of view. The special inspection advocated in the paper would cost a good deal of money, and he doubted if there would be a corresponding return. The principal health requirements were perfect eyesight and good hearing, and these could be tested by a member of the tramway staff as well as a doctor. He engaged all men on three months' trial, and thought that a reference to the daily reports before making the appointment permanent amply guarded the undertaking against other risks.

Dr. Collie, the medical officer for the London County Council Tramways, then gave some valuable and interesting figures. Pointing out that the public safety depended upon the health of tramway conductors and motormen, he said that out of 100 men examined he had found 13 wholly unfit for employment as drivers, six being entirely and seven partially colour blind. At another time, out of 2,733 men examined, 65 proved to be colour blind, while 2,486 were thoroughly satisfactory, the remaining 182 failing for other reasons. He then described the manner in which the tests were made, remarking that railway companies not only demand perfect vision, but insist on a driver being re-examined at all stages of promotion. As to the importance of a thorough examination of all applicants for employment, he stated that out of 1,681 men examined as they would be for insurance purposes, 1,502 passed, 10 were deferred for re-examination, and of the others, 10 were rejected for heart disease, 16 for varicose veins, 91 for defective vision, 13 for kidney disease, and the other 39 for other causes. He then instanced the practice of the London County Council and the steps he had found it necessary to take to prevent malingering, concluding by stating that when dealing with thousands of men, independent medical inspection does pay, and the doctor's fees are fully justified.

Mr. Smithson, the chairman of the Leeds Tramway Committee, said that the subject had been fully considered by his committee, who had decided to have each applicant for employment examined by a general practitioner at a cost of 3s. 6d. per case. He felt that in future the public would insist upon medical examination of all persons placed in charge of tramcars.

Mr. J. Dalrymple, the general manager of the Glasgow tramway system, was in agreement with the principle of medical examination, but thought that the preliminary tests could be made by members of the tramway staff, only doubtful cases being referred to the medical officer for detailed test.

Mr. McElroy, of Manchester, wondered why the Board of Trade, who were so particular in other respects, were so indifferent to the human factor of safety on a tramway system, and did not insist on medical examination.

Dr. Chapman, in reply, stated that the discussion had confirmed him in the view that not only should medical examinations be made, but that they should be carried out by independent specialists.

Mr. W. E. Ireland, rolling stock superintendent of the London County Council, then read a paper descriptive of "The Central Repair Depôt of the London County Council." Owing to the late hour, discussion on this paper was deferred till Thursday morning. The Association dinner was held in the evening at the Garden Club, Imperial International Exhibition, Shepherd's Bush, and proved very enjoyable.

On the reassembling of the Conference on Thursday morning, Mr. Yerbury, of Sheffield, Mr. Spencer, of Bradford, and Mr. Rayner, of Doncaster, spoke on questions arising out of Mr. Ireland's paper, but in view of the visit to the depôt, which had been arranged for the afternoon, any detailed discussion was by general consent deferred.

Mr. A. R. Fearnley, the general manager of the Sheffield tramways, then read a paper entitled "Some Comparisons of Continental and British Methods of Operating Tramways." The discussion centred on the question of type and size of car overloading of cars, the use of trailers, provision of shelter and bow form of collector *versus* trolley.

Mr. F. Ayton, of Ipswich, considered the bow collector superior to the trolley on account of the lessened wear of the trolley wire at the ears, and also in that no time need be lost in reversing at terminals.

Alderman Smith, the deputy-chairman of the Liverpool Tramways Committee, said that they had tried single-deck cars of the type used both in America and at Hamburg, but they were not liked, and had been abandoned. They had not found any serious difficulty due to delay in getting in and out of the double-deck car, and they were adopting this type wherever possible.

Mr. Mozley, the general manager of the Burnley tramway undertaking, opposed the proposal to use trailer cars, regarding it as retrograde and reminiscent of old steam practice. He considered the suggestion to use vestibule cars good, and, in fact, was adopting it in combination with the reversed staircase in all new rolling stock for his line; he created some amusement by reminding the Conference that he had designed a reversed staircase before Liverpool had had one made.

Mr. A. Blaylock, the deputy-chairman of the Birkenhead Tramways Committee, said that the shelters they had erected had cost £60 to £80 each, in place of the £30 or £40 mentioned by Mr. Fearnley.

Mr. Hamilton, general manager, Leeds Tramways, pointed out that when the Glasgow system was first electrified they tried to popularise the single-deck car, but were unsuccessful. The people were used to double-deck cars, which afforded convenient accommodation for smokers, and as a result the use of the double-decked car was now universal on the system. He disagreed with the view that vestibule cars were desirable, and thought that in certain circumstances the rail-less trolley system might be found useful.

Mr. C. J. Spencer, general manager, Bradford Tramways, asked if it was necessary to confine the use of trailers to routes laid throughout with double track? He was in favour of compulsory stopping places, as their abandonment would decrease the average speed by 25 per cent. In view of the low average fare in this country, he did not think that they could afford such luxuries as waiting rooms, as these to be properly kept, needed an attendant.

Bailie J. Macfarlane, convener of the Glasgow Tramway Committee, agreed with Mr. Hamilton that the single-decked cars at Glasgow had been consigned to the scrap heap, and was of opinion that for general use the covered double-deck car was the best. He would, however, strictly forbid overcrowding. In busy centres he did not think shelters were necessary, but at suburban termini, where there were only three or four cars per hour, they might be provided, an attendant being required. He might remind the Conference that cities did not exist for tramways, but tramways to minister to the needs of the city. He suggested that in any applications which might be made to Parliament for powers to run railless trolley lines, local authorities should be forbidden to charge rates on the poles and overhead apparatus.

Mr. S. C. T. Neumann, deputy-chairman of the Bradford

Tramway Committee, did not think attendants were needed to be constantly on duty in shelters, and raised the question as to whether overcrowding should be allowed on tramcars. Pleading for the comfort of passengers, he remarked that at Bradford they seemed to have one rule permitting standing on single deck, and another forbidding it on double-deck cars.

Mr. P. Fisher, general manager at Dundee, showed how they had got over the difficulty of finding attendants for their shelters by allowing the attendant in return for keeping the room clean to sell papers, stationery, postcards, &c.

Mr. Fearnley then replied to the various questions raised, and regret having been expressed that there was no time for Mr. Pilcher's paper on "Current Consumption," the Conference adjourned for luncheon at the Holborn Restaurant, on the invitation of the chairman and members of the Highways Committee of the London County Council.

A large party afterwards assembled on the Embankment opposite the new building of the Institution of Electrical Engineers, and were conveyed in three special tramcars of latest type to the Car Repair Depôt at Charlton. The route taken was *via* the new line over Blackfriars Bridge, Old Kent Road, New Cross and Greenwich. Arriving at the depôt, complete arrangements had been made for inspecting the workshops in groups personally conducted by responsible officials. Much interest was felt in the systematic manner in which the work is carried out at the depôt, and the way in which the workshops have been equipped. The utility of the visit was greatly enhanced by the detailed description which had been presented to the Conference in Mr. Ireland's paper.

The party were then taken in the special cars to the Greenwich generating station, about a mile distant, when, after partaking of tea on the invitation of Mr. A. L. C. Fell, the President of the Association, a pleasant time was spent in inspecting this well-known power house. The cars were again requisitioned and the party taken *via* New Cross, Kennington and Westminster to the Embankment, where they dispersed in anticipation of again meeting at the reception given by the Lord Mayor of London at the Mansion House later in the evening.

The business meeting of the Association was held on Friday morning, after which an excursion was made to Windsor, where, after an inspection of the Castle, the party were received in the Guildhall by the Mayor of Windsor, and subsequently entertained at tea.

The annual report of the Executive Committee for the past year mentions that the question of depreciation allowances for wear and tear of tramway and light-railway undertakings has been settled with the Inland Revenue Department; the report of the Special Committee on Brakes has been issued to members, and a short supplementary report has been drawn up comparing the conclusions with those in the report of the Tramways and Light Railways Association.

A special committee is investigating the question of rail corrugation, and the services of Mr. C. A. King, B.Sc., have been retained to aid in this work.

The Committee has appointed a special committee to report on a scheme for the measurement and charging for energy supplied by combined stations to tramways departments; the matter may be jointly considered with the Municipal Electrical Association.

Tramway Problems.

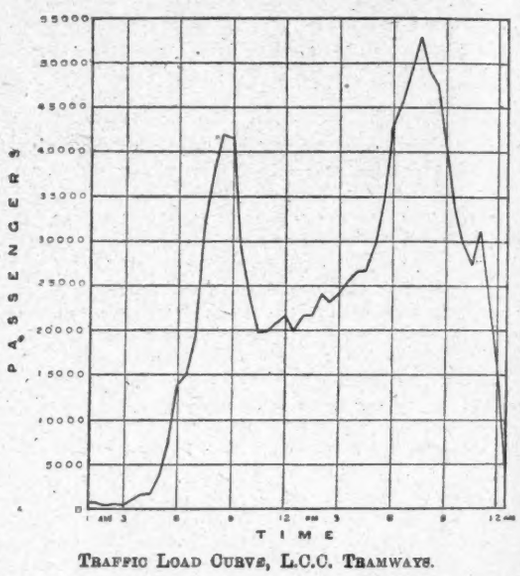
In the course of his Presidential address last week, Mr. A. L. C. Fell touched upon several interesting matters to which we could only briefly refer in our leader. Drawing attention to the unfair burden of cost laid upon the tramway authority for paving the roadway, he pointed out that the local road authority could stipulate what paving should be used, and generally selected wood and soft granite paving which required constant attention and renewal, with consequent interference with all classes of traffic. Besides bearing the first cost and maintenance of the roadway, the tramway authority has to pay rates based on the earning capacity of the line, while competing companies have the free use of the roads and pay rates only on their stables and depôts, so that the latter are practically subsidised by the ratepayers.

Mr. Fell maintained that the introduction of tramways, contrary to the popular belief, relieved the congestion of traffic, the slow traffic being diverted to the side of the road, while the fast traffic followed the tramway.

The tramcar took up less space per passenger seat than any other type of public street vehicle, and thanks to the roof cover, was enabled to carry its full complement of passengers in all weathers. In wet weather one car could carry as many passengers under cover as five motor-omnibuses, which, even if no space were left between them, would occupy a length of 115 ft., against 33 ft. 10 in., taken up by the car.

The President claimed that tramways were in every way more suitable than railways for dealing with short-distance traffic, and gave data for the larger cities, showing that out of nearly 1,000,000,000 passengers, over 78 per cent. paid ½d. or 1d., and travelled less than two miles. Railway companies, therefore, should confine their attention to the long-distance suburban passenger (the London tubes were not included in this connection). Tramway authorities should co-operate with the railways, rather than compete with them.

Regarding the rail-less trolley system, he thought it might be useful in certain cases, but that in ordinary service the cost of maintenance would be too high. It was not likely to be of much



Traffic Load Curve, L.C.C. Tramways.

service for experimenting on new routes, for people would not settle down on a new route unless a tramway were laid, which would encourage a feeling of permanency and security.

Mr. Fell strongly emphasised the necessity of standardisation wherever possible—not only in the parts of the cars and equipments, but also in the annual reports and accounts of tramway undertakings. The "car-mile" was a most unsatisfactory unit, owing to the wide variations in conditions of size, weight, speed and number of stops of the cars. The "seat-mile" should be given in all comparative figures.

On the use of trailer cars, there was a division of opinion; he thought that if double-decked trailers were used, the maximum benefit would be realised, and he had made arrangements for trailers to be employed experimentally on one route in London.

The conditions of labour on tramways, as regarded the working hours, depended on the habits of the community; in London, unfortunately, there was a very high peak for a short time in the morning, and again in the evening (fig. 1), so that a large number of cars had to be run at those times only, 40 per cent. of the cars being laid off between 10 a.m. and 4 p.m. (see fig.). In places where the tramways passed through the centre of the city, a considerable mid-day traffic was obtained, and in the provinces many people went home to dinner, so that a more uniform service could be run. The only remedy for the slackness in the middle of the day appeared to be the introduction of a heavy-goods service in conjunction with the railway and dock undertakings, which would relieve the congested traffic in the main streets, and, in many cases, remove the necessity for street widenings.

Conciliation Boards had been organised in connection with the L.C.C. undertaking, with the approval of the great majority of the men. Four Sectional Boards had been elected, respectively connected with the traffic, rolling stock, electrical and permanent way departments, and the machinery for dealing with difficulties would soon be in working order. Matters of discipline, however, should not be dealt with through this channel; the manager should be given full authority to deal with such questions—it was a fatal thing if any employé were allowed to approach a Committee without his knowledge.

In 1902 he had strongly advocated the adoption of steel wheels, on the ground of his experience in Sheffield, but at the time his remarks were subjected to many adverse criticisms; now, with a few exceptions, steel wheels had been adopted throughout the country. According to replies from 53 municipal tramways, out of 35,600 wheels in use only 2,536 (7 per cent.) were of chilled iron. The life of modern steel tires exceeded the most sanguine expectations of seven years ago.

The President condemned the adoption of halfpenny fares on the smaller tramway systems, though he thought they were justifiable on the large city systems; yet he questioned whether these extremely low charges were compatible with the proper discharge of their financial obligations, the due conduct of the services, and

the adequate maintenance of track and equipment, and he deprecated the hasty adoption of the halfpenny as a standard fare. It was a valuable asset on large systems if short stages were adopted, but there was a tendency to lengthen th se stages until they became unprofitable; tramways should not only serve the public well, but also pay their way.

British tramway installations, he said, were now looked upon all over the world as examples of solid permanent work. Twenty years hence tramways would predominate, motor-omnibuses would be curiosities, and railways would deal only in long-distance traffic, leaving all internal pick-up traffic to the tramways, which would act as feeders to the railways.

The Medical Examination of Tramway Employés.

A paper with this title was read by Councillor A. W. Chapman, M.B., C.M., J.P., Deputy-Chairman, Manchester Corporation Tramways Committee, and in every respect it tallies with the views which we have expounded from time to time.

The value of this paper cannot be lightly estimated, and its importance arises from several causes. First, the paper is the work of an eminent physician; secondly, the contents of the paper represent the views of one of the chief Corporations in the country; and lastly, the author declares openly that the necessity for strict medical examination has become urgent since the Compensation Acts have piled legal responsibilities and heavy monetary burdens on employers, threatening, for the same reason, to become still more pressing.

The last two factors in this estimate of the importance of the paper are the most interesting, for they indicate a reactionary tendency. For a decade or more our municipal bodies have been educating themselves in a school of progressive socialism, with the natural result that their actions and policies have been greatly influenced by their ever-growing staffs. We are not now concerned with the whole range of consequences, but merely with the one deplorable fact that the fear of the wrath to come from their own employés has prevented a municipal body many a time from expressing opinions or proposing reforms or new projects, which bore any semblance of interference with the privileges of the new caste.

Nothing but this has stood in the way of compulsory medical examination of all those employés of a tramway committee who in some measure have the safety of the public in their hands.

Something has been done to remedy this degrading state of affairs in very recent times, for Dr. Chapman refers to 21 undertakings which have all car-crews medically examined before entering the service, but there has been nothing like a general adoption of this precaution.

But this paper sounds a call to which no one can be deaf. It will help to rend the veil which is drawn across the shrine of labour, and by its aid the blindest will see that the combination of workmen's compensation, increased pay, shortened hours, holidays with pay, and general pampering and pandering, is not compatible with a prosperous undertaking, unless the efficiency of the staff is increased in something like proportion to the expenditure.

Dr. Chapman holds strongly that all employés should be medically examined before being received into service, and re-examined every five years. In his opinion, the examination should be of the most searching character, and should include especial attention to sight and hearing, which brings the examination even higher than that of a life insurance office.

Dr. Chapman does well to reproduce the emphatic declarations of the two Brakes Committees on this point, and it will do no harm to refresh our readers' memories from the same sources:—

Municipal Tramways Association.

"No man ought to be appointed a driver of an electric tramcar who has not first passed a careful medical examination. A rigid and careful examination as to fitness in handling a car should be made by a responsible officer, after the man has been thoroughly trained in his duties. The supervision in the training of drivers should, where practicable, be done by one man, in order to secure uniformity. Periodical testing (medical and practical) of men is a necessity of safety."

Tramways and Light Railways Association.

"*Physical Unfitness.*—The Committee wishes to lay special emphasis on this point. In their opinion it is essential that all motormen should undergo a medical examination and eyesight tests, and they would also recommend periodical re-examination."

Most people will agree with Dr. Chapman that the Workmen's Compensation Act and the Employers' Liability Acts have rendered it necessary for the better protection of any business undertaking, such as a tramway, to extend the medical examination over the whole staff, although, apart from these Acts, there would appear to be little call to examine any but drivers.

Medical examination was instituted in the Manchester tramways department in June, 1908, and 16 per cent. of those who applied for employment and of those employés who were considered otherwise fit for promotion, were rejected for medical reasons, by far the greatest number failing through defective eyesight.

An appendix to the paper reproduces the categoric statement which has to be answered by every candidate, and the form of report sent in by the doctor to the general manager. The former has the advantage of briefness over many American declarations which we have seen, and it is of no less value on that account.

Before the next Conference meets, there should be many more adherents to this sound policy of getting as good value as possible for the money paid.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

NEW UNITED STATES TARIFF (*concluded*).

	Old Tariff.	New Tariff.
Porous carbon pots for electric batteries, without metallic connections	20 % ad val.	20 % ad val.
Glass articles composed wholly or in chief value of glass, ornamented or engraved	60 % ad val.	60 % ad val.
Iron or steel wire rods, whether round, oval, flat or square, or in any other shape:		
Valued at 4 c. or less per lb.	$\frac{4}{10}$ c. per lb.	$\frac{3}{10}$ c. per lb.
Valued over 4 c. per lb. ...	$\frac{6}{10}$ c. per lb.	$\frac{6}{10}$ c. per lb.
Notes.—(1) All round iron or steel rods smaller than No. 6 wire gauge shall be classed and dutiable as wire.		
(2) All iron or steel wire rods which have been tempered or treated in any manner or partly manufactured shall pay an additional duty of	½ c. per lb.	½ c. per lb.
Iron or steel wire, round:		
Not smaller than No. 13 wire gauge	1¼ c. per lb.	1 c. per lb.
Smaller than No. 13 and not smaller than No. 16 wire gauge	1½ c. per lb.	1¼ c. per lb.
Smaller than No. 16 wire gauge	2 c. per lb.	1¾ c. per lb.
* Note.—All the foregoing shall pay duty at not less than 35 % *ad valorem*.		
* The Note in the former tariff read as follows:—"All the foregoing valued at more than 4 c. per lb. shall pay 40 per cent. *ad valorem*."		
All wire composed of iron, steel, or other metal except gold or silver, covered with cotton, silk or other material, and all flat wires, and steel in strips, not thicker than No. 15 wire gauge and not exceeding 5 in. in width, whether in long or short lengths, in coils or otherwise, and whether rolled or drawn through dies or rolls, or otherwise produced, and all other wire not specially provided for in this section shall pay a duty of not less than ...	(See below.)	35 % ad val.
Iron or steel or other wire not specially provided for, and sheet-steel in strips, $\frac{3}{1000}$ in. thick or thinner; any of the foregoing, whether uncovered or covered with cotton, silk, metal or other material, valued at more than 4 c. per lb. ...	45 % ad val.	—
Iron or steel wire coated by dipping, galvanising or similar process, with zinc, tin or any other metal, in addition to the rate imposed on the wire from which it is made	$\frac{3}{10}$ c. per lb.	$\frac{3}{10}$ c. per lb.
Articles manufactured wholly or in chief value of any wire or wires provided for in this paragraph, in addition to the maximum rate of duty imposed in this section upon any wire used in the manufacture of such articles	1¼ c. per lb.	1 c. per lb.
Note.—No article made from or composed of wire shall pay a less rate of duty than 40 per cent. *ad valorem*.*		
* This provision did not appear in the former Tariff.		
Telegraph, telephone and other wires and cables composed of metal and rubber, or of metal, rubber and other materials ...	(Not specified.)	40 % ad val.

	Old Tariff.	New Tariff.
Axles or parts thereof, axle bars, axle blanks or forgings for axles, whether of iron or steel, without reference to the stage or state of manufacture, not otherwise provided for in this section, valued at not more 6 c. per lb.	1 c. per lb.	¾ c. per lb.
NOTE.—When iron or steel axles are imported fitted in wheels, or parts of wheels, of iron or steel, they shall be dutiable at the same rate as the wheels in which they are fitted.		
Cast-iron pipe of every description	1/10 c. per lb.	¼ c. per lb.
Lap-welded, butt-welded, seamed or jointed iron or steel tubes, pipes, flues or stays, not thinner than No. 16 wire gauge:		
If not less than ⅝ in. in diameter	2 c. per lb.	1 c. per lb.
If less than ⅝ in. and not less than ¼ in. in diameter ...		1½ c. per lb.
If less than ¼ in. in diameter ...		2 c. per lb.
NOTE.—No tubes, pipes, flues or stays made of charcoal iron shall pay a less rate of duty than 1½ c. per lb †		
† This note did not appear in the former Tariff.		
Flexible metal tubing or hose, not specially provided for in this section, whether covered with wire or other material, or otherwise, including any appliances or attachments affixed thereto	(Not specified.)	30 % ad val.
All other iron or steel tubes, finished, not specially provided for in this section ...	35 % ad val.	30 % ad val.
Wheels for railway purposes, or parts thereof, made of iron or steel, and steel-tired wheels for railway purposes, whether wholly or partly finished; and iron or steel locomotive, car, or other railway tires or parts thereof, wholly or partly manufactured	1½ c. per lb.	1¼ c. per lb.
Ingots, cogged ingots, blooms, or blanks for the same, without regard to the degree of manufacture	1¼ c. per lb.	1 c. per lb.
NOTE.—When wheels for railway purposes, or parts thereof, of iron or steel, are imported with iron or steel axles fitted in them, the wheels and axles together shall be dutiable at the same rate as is provided for the wheels when imported separately.		
Manufactures of metal not separately mentioned in the tariff including machinery, &c.	45 % ad val.	45 % ad val.

NEW PATENTS APPLIED FOR, 1909.

(NOT YET PUBLISHED.)

ompiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

20,857. "Improvements in or connected with the trolleys of overhead electric traction systems." G. HILL and F. HILL. September 13th.

20,867. "Improvements in motor-generators, boosters, balancers, auto-transformers, and generators for direct currents." A. M. TAYLOR. September 13th.

20,869. "Apparatus that will automatically regulate and keep a constant and even voltage on any number of electrical machines running in parallel and supplying current to an electric circuit and prevent current passing between the machines other than that supplied to the circuit." W. J. WALTERS. September 13th.

20,882. "Improvements in portable electric lampholders." H. B. JENKINS. September 13th. (Complete.)

20,899. "Improvements in and relating to the excitation of commutator generators." ACT.-GES. BROWN, BOVERI ET CIE. (Date applied for under Sec. 91 of the Act, November 9th, 1908, being date of application in Germany.) September 13th. (Complete.)

20,908. "Method of and means or apparatus for automatically controlling two or more electric circuits." G. C. FRICKER. September 13th.

20,990. "Improved electro-magnetic buzzer operated by means of alternating current." L. P. HUTT. September 14th.

21,002. "Improvements relating to telephonic apparatus." E. A. GRAHAM. September 14th. (Complete.)

21,008. "Improvements in arc lamps." L. L. D. CIBIE. September 14th.

21,021. "Improvements in the installation of electrical conductors." J. S. HIGHFIELD. September 14th.

21,042. "New or improved controlling device for reversible direct-current electric motors." A. J. HURST. September 14th.

21,065. "Electric alarm thermometer." R. STERICKER and G. TINDALE. September 15th.

21,070. "Improved magnetometer." J. C. BAGOT. September 15th.

21,090. "Improvements in and relating to electric signalling apparatus for railways and the like." J. GOLDSCHMIDT. September 15th.

21,093. "Improvements in electric incandescence lamp fittings." J. H. CUNNINGTON. September 15th. (Complete.)

21,101. "Improvements in and relating to signal systems." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) September 15th.

21,109. "Improvements in means for securing electric incandescent lamps." C. DAMEY. September 15th. (Complete.)

21,113. "Improvements in electrical regenerative control apparatus and systems." CROMPTON & CO., LTD., J. C. MACFARLANE and H. BURGE. (Date applied for under Rule 13, March 3rd, 1909. An invention comprised in Application No. 5,168, March 3rd, 1909.) September 15th. (Complete.)

21,156. "Improved electrical advertising arrangement." E. BROWN. September 16th.

21,157. "Improvements in motor-generators, boosters, balancers, and auto-transformers for direct or alternating current circuits." A. M. TAYLOR. September 16th.

21,161. "Improved burglar alarm." A. W. WINDSOR. September 16th.

21,179. "Improvements in and relating to homopolar generators and motors, and other electrical machines having a large number of collector wings." R. H. BARBOUR. September 16th.

21,180. "Improvements in and relating to flexible electrical brushes or collectors." R. H. BARBOUR. September 16th.

21,190. "Improvements in electric telegraphs, particularly applicable to transmitting signals on board ships." W. F. GRAFTON. September 16th.

21,219. "Improvements in or relating to systems for the distribution of electric energy." W. F. ANDERSON, S. A. RUSSELL and W. E. GRAY. September 16th. (Complete.)

21,222. "Improvements in the manufacture of iron poles for telegraphs, telephones, and the like." J. H. SKINNER. September 16th. (Complete.)

21,239. "Improvements in the methods of charging and discharging secondary batteries or electric accumulators." A. M. TAYLOR. September 17th.

21,249. "Improvements in alternating-current motor-controllers." G. A. E. KOHLER. September 17th. (Complete.)

21,261. "Improvements in drums or reels for coiling or transporting electric cables, wire, ropes, and the like." September 17th.

21,285. "Improvements in metal-filament incandescent electric lamps." H. ZSCHOCKE. September 17th. (Complete.)

21,303. Improvements in and relating to selective switch systems applicable to electric traction systems and for other purposes." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) September 17th.

21,340. "Improved locking device for electric incandescent lamps." J. H. HALLIWELL. September 18th.

21,343. "Improvements in switches for breaking electrical circuits." W. C. KIRWAN and K. QUANEY. September 18th.

21,357. "Improvements in electric motor-starting and speed-controlling apparatus." A. C. HEAP. September 18th.

21,374. "Improvements in electrodes for arc lamps." GEBRUDER SIEMENS AND CO. (Date applied for under Sec. 91 of the Act, October 5th, 1908, being date of application in Germany.) September 18th. (Complete.)

PUBLISHED SPECIFICATIONS.

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1908.

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ELECTRIC CELLS. J. Spiliotopol. 18,115. August 28th.

SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. H. Ducros. 18,120. August 28th.

THERMO-ELECTRIC PILES. A. Ritterhaussen. 18,277. August 31st.

ELECTRIC SOUNDING FORK VIBRATOR FOR THERAPEUTIC AND LIKE PURPOSES. L. Muller. 18,326. September 1st.

ELECTRICAL FUSES. H. J. Fuller. 20,830. October 3rd.

ADJUSTABLE NON-PORTABLE ELECTRICALLY-DRIVEN MACHINES FOR GRINDING, SAWING, MILLING, BORING, DRILLING AND THE LIKE. G. Robson and R. Marshall. 20,988. October 5th.

ELECTRICAL COMMUTATORS FOR USE IN IGNITION SYSTEMS OF INTERNAL-COMBUSTION ENGINES. E. G. Cleverly and F. L. Anderson. 21,740. October 4th.

ELECTRICAL CONNECTIONS WITH RODS OF SILUNDUM OR THE LIKE HAVING COMPARATIVELY POOR CONDUCTING QUALITIES. G. Cooper and F. Sharp. 22,627. October 24th.

METHOD OF AND APPARATUS FOR CONTROLLING ELECTRIC CRANES. E. M. Holme. 23,111. October 30th.

PORTABLE ELECTRICALLY-DRIVEN DRILLING MACHINES. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges., 26,685. November 5th.

1909.

SAFETY BOX FOR PACKING INCANDESCENT ELECTRIC LAMPS. M. I. Cooper. 341. January 5th.

ELECTROMAGNETIC SYSTEMS FOR CONTROLLING LIGHTS ON RAILWAY TRAINS, APPLICABLE ALSO TO THE CONTROL OF VALVES OR TAPS FOR OTHER PURPOSES. Siemens Bros. Dynamo Works, Ltd., Broadhead & Hawkins. 4,425. February 23rd.

ACCUMULATOR PLATES. Accumulator-Fabrik Akt.-Ges. 6,248. March 16th. (Date applied for under International Convention, December 31st, 1908.)

SIGNALLING SYSTEMS FOR RAILWAYS AND THE LIKE. British Thomson-Houston Co. (General Electric Co.) 6,985. March 23rd.

TELEMOTOR GEAR. J. MacKintosh. 7,048. March 24th.

ELECTRICAL SWITCHES. A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. 7,903. April 5th. (Application for Patent of Addition to No. 6,899/07.)

METHOD FOR REGENERATING BLACKENED CARBON-FILAMENT ELECTRIC LAMPS. E. A. Krüger. 8,283. April 6th. (Date applied for under International Convention, April 6th, 1908.)

ELECTRICAL SWITCHES. A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. 8,429. April 7th.

ELECTRIC SIGNALLING SYSTEMS FOR RAILWAYS AND THE LIKE. J. D. Taylor. 1,788. January 25th. (Date applied for under International Convention, January 30th, 1908.)

ELECTRIC SWITCHES. W. H. Flood. 3,628. February 13th.

ELECTRICAL RELAY. M. S. Conner. 4,399. February 23rd.

PROTECTIVE DEVICES FOR ALTERNATING-CURRENT SYSTEMS. Allgemeine Elektricitäts Ges. 4,705. February 25th. (Date applied for under International Convention, February 25th, 1908.)

SYSTEMS OF ELECTRIC MOTOR CONTROL. H. E. White. 6,587. March 18th. (Date applied for under International Convention, May 18th, 1908.)

TERMINALS FOR SWITCHBOARDS. H. Brand. 11,267. May 19th.